DECEMBER 1958

Power Engineering

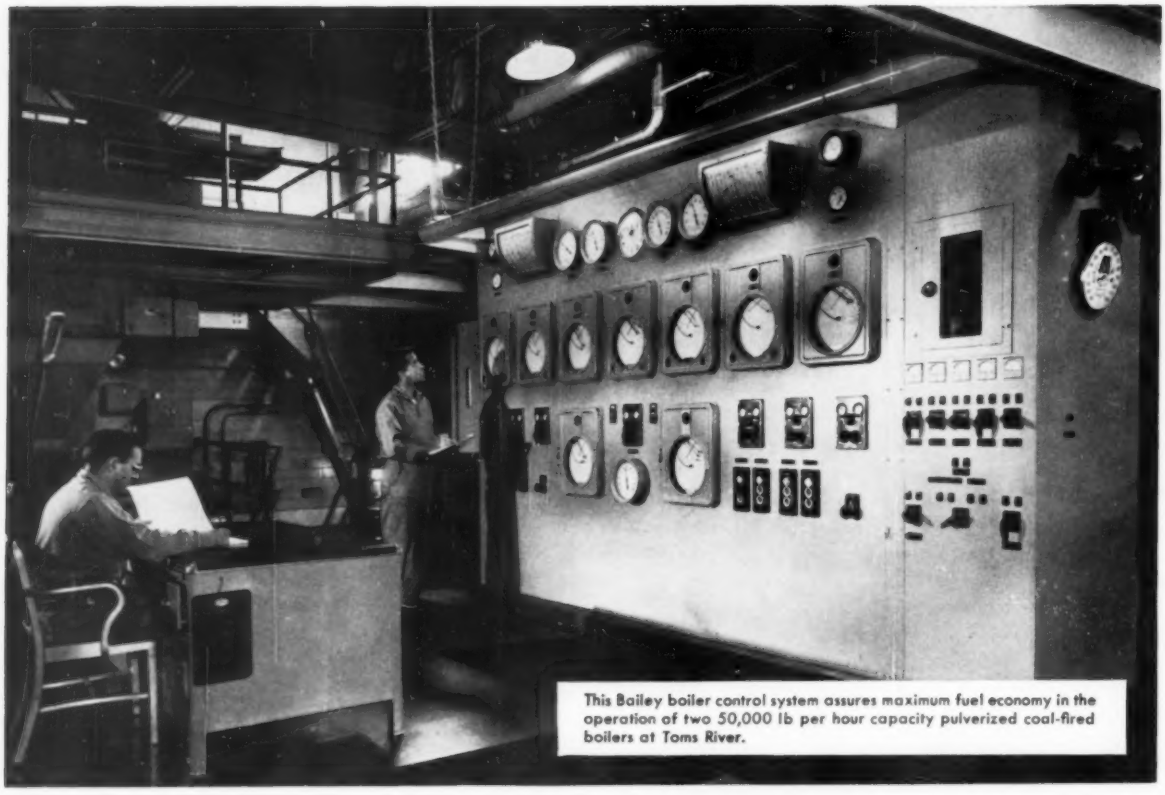
ATOMICS

Project Sherwood 43
Atomic Power Development at Westinghouse 44
Test Assembly for Nuclear-Powered Aircraft 50
New Nuclear Literature 52

Designing Small Power Plants For Net Earnings 70
Cyclone Furnace and Fly Ash Return at Kodak Park 72
Dow Plant Lubricates For Long Life 74
Line Capacity Increase Through Power-Factor Correction 76
Fuel For Tomorrow's Power 80
Hydrazine Assures Effective Deaeration 84
How Do Environmental Test Chambers Work? 86
Transistors vs Magnetic Amplifiers 88
Have You Tried NISA? 90
DePauw Cuts Costs In Plant Remodeling 91
Trends in Central Control Systems 93
1958 Annual Editorial Index 129

REGULAR DEPARTMENTS

Engineers' Preview 3
What They Tell Us 6
Helpful Bulletins 25
TRACERS 69
News Reel 82
Construction News 95
POWER ENGINEERING Handbook 96
Equipment News 104
Reader Service Post Cards 119
Catalog Library 120
Advertisers Index 128
Circulation of This Issue 42,703



This Bailey boiler control system assures maximum fuel economy in the operation of two 50,000 lb per hour capacity pulverized coal-fired boilers at Toms River.

How Bailey helps control STEAM COSTS AT TOMS RIVER

With a Bailey-engineered control system you can count on a high output of available energy per unit of fuel, whether you operate a small industrial boiler or a large central station boiler.

They did at Toms River — Cincinnati Chemical Corporation's plant in Toms River, N. J.! Bailey Controls help them save fuel by continuously maintaining desired operating conditions.

Most high-efficiency steam generating plants rely on Bailey because:

1. A Complete Line of Equipment

Bailey manufactures a complete line of standard, compatible pneumatic and electric metering and control equipment that has proved itself. Thousands of successful installations involving problems in measurement, combustion and automatic control are your assurance of the best possible system.

2. Experience

Bailey Engineers have been making steam plants work more efficiently for more than forty years. Veteran engineer and young engineer alike, the men who represent Bailey, are storehouses of knowledge on measurement and control. They are up-to-the-minute on the latest developments that can be applied to your problem.

3. Sales and Service Convenient to You

There's a Bailey District Office or Resident Engineer close to you. Check your phone book for expert engineering counsel on your steam plant control problems.

AI39-1

Instruments and controls for power and process

BAILEY METER COMPANY

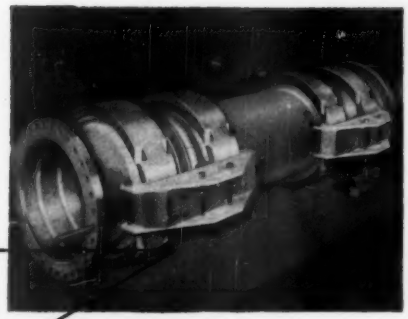
1040 IVANHOE ROAD • CLEVELAND 10, OHIO

In Canada—Bailey Meter Company Limited, Montreal

BAILEY METERS

For more data circle 501 on Post Card

ALL IN A DAY'S WORK at *Pittsburgh Piping*



Every Pittsburgh Piping job is different, but all are alike in one respect . . . to control the flow and harness the energy of high temperature steam, gases, or liquids at high pressures. It's all in a day's work at Pittsburgh Piping to fabricate piping for a central station, an atomic energy installation, or for industrial and processing operations. Our service includes every phase from blueprint through erection: engineering, metallurgical control, pipe bending, machining, welding, heat treating, inspection, and testing. Use these facilities on your high temperature, high pressure piping jobs.

this BIG 10-TON EXPANSION JOINT

36" carbon steel joint, weighing ten tons, for cross-over piping in central station.

and this small PRESSURE RISER CONDENSER

Pressure riser condenser, fabricated of Stainless Steel Type 347; 2 feet high; wall thickness equivalent to 4" Schedule 160S. Stainless steel pressure vessel, for atomic energy application, appears in background.

Promoting Progress ***IN POWER AND PROCESS PIPING***

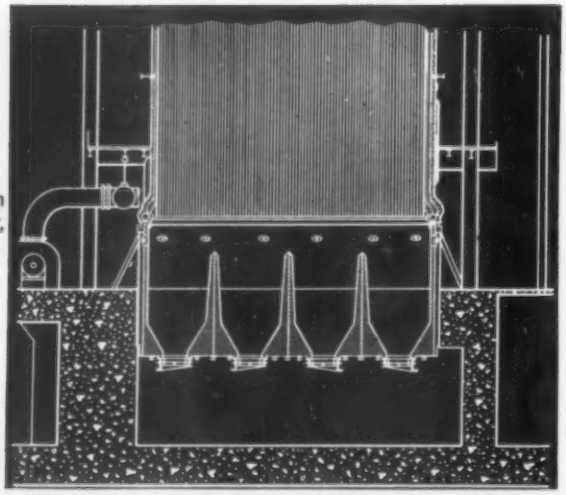
Pittsburgh Piping **AND EQUIPMENT COMPANY**
158 49th Street—Pittsburgh, Pa.

Canada: **CANADIAN PITTSBURGH PIPING, LTD.,** 68 YONGE STREET—TORONTO, ONTARIO

Atlanta.....Whitehead Building
Chicago.....Peoples Gas Building
New York.....Woolworth Building
Cleveland.....Public Square Building
New Orleans.....P. O. Box 74

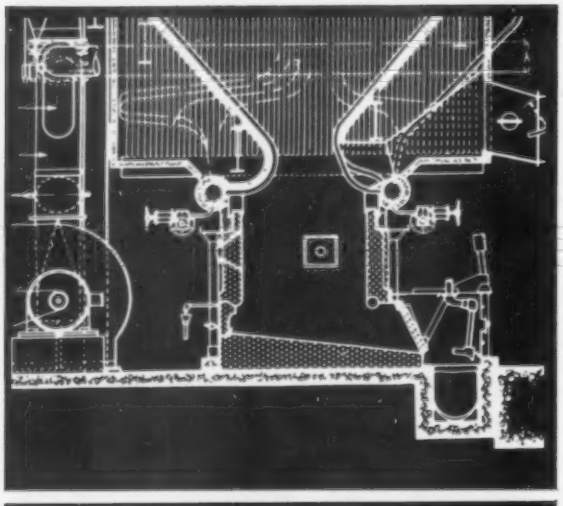
For more data circle 502 on Post Card

Erosion, due to dry ash sliding down the hopper, is the big problem in this ashpit.



Reduce refractory wear in ashpits with B&W Kaocrete

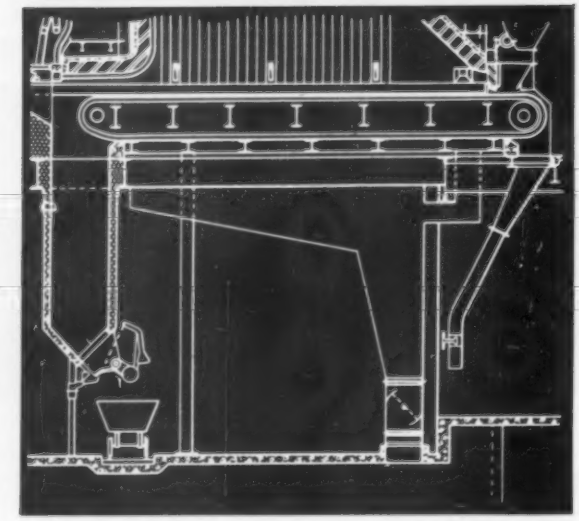
Water jets can cause abrasion of ashpit floor refractories, and water splattered on the walls may cause spalling.



Relining ashpits is expensive. That's why power engineers specify heavy-duty B&W Kaocrete-D. On job after job, in all types of ashpits, this refractory castable has withstood the heavy abrasive and erosive attacks of sprays, jets, rakes and shovels.

The reason? Specially designed B&W Kaocrete-D has the strength and hardness needed for tough ashpit service. It has unusually high resistance to abrasion, erosion and spalling. It also saves time because it can be cast or gunned in place.

Continuous deposits of ash from a stoker-fired boiler have an abrasive effect on this ashpit lining.



For the facts and figures on Kaocrete-D, as well as Kaocrete-A which is recommended for less severe applications, consult your local B&W Refractories Engineer.

Send for Bulletin R-40 which gives data on B&W Kaocrete Refractory Castables for lining ashpits.

R605

BABCOCK & WILCOX
THE BABCOCK & WILCOX CO.
REFRACTORIES DIVISION
GENERAL OFFICES: 161 EAST 42nd ST., NEW YORK 17, N.Y.
WORKS: AUGUSTA, GA.

B&W REFRACTORIES PRODUCTS: B&W Allmul Firebrick • B&W 80 Firebrick • B&W Junior Firebrick • B&W Insulating Firebrick • B&W Refractory Castables, Plastics and Mortars • B&W Silicon Carbide B&W Ramming Mixes • B&W Kaowool

For more data circle 503 on Post Card

EDITORIAL AND BUSINESS STAFF

POWER ENGINEERING IS PUBLISHED MONTHLY
308 E. JAMES ST., BARRINGTON, ILL.
DUnkirk 1-1840
Chicago NEwcastle 1-0488

EDITORIAL AND ART STAFF

Editorial Director	Richard H. Morris
Editor	Chester R. Earle
Managing Editor	Robert F. McCaw
Associate Editor	Welden Reynolds
Associate Editor	Charles T. Maxwell, Jr.
Associate Editor	Jeff Hunnicutt
Equipment Editor	Marian E. Heniken
Editorial Assistant	Mildred Novosel
Art Director	James E. Wilcox
Staff Artist	Richard Trefilek
Artist-Draftsman	Ted Cieplay
Editor of ATOMICS	Andrew W. Kramer

OFFICERS AND BUSINESS STAFF

President	Kingsley L. Rice
Executive Vice President	Edwin C. Prouty
Treasurer	Arthur L. Rice, Jr.
Secretary	Edwin C. Prouty, Jr.
Production Director	John O. Aarvold
Production Manager	Earl R. Noren
Assistant Advertising Manager	Josephine Gear
Research Director	Eugene Zucker
Research Associate	Margaret Hoagland
Technical Assistant to President	Andrew W. Kramer

DISTRICT MANAGERS

Chicago 3, Ill. 110 S. Dearborn St.	Warren F. Saas DEarborn 2-5453
New York City & New England 842 Graybar Bldg. New York 17, N. Y.	William H. Relyea, Jr. LEXington 2-0308
Philadelphia, Pa., and New Jersey 15 Sunrise Drive Morris Plains, N. J.	Joseph E. Halloran JEfferson 8-7873
Pittsburgh 19, Pa. 404 Frick Bldg.	Robert R. Anderson COurt 1-4940
East North Central 2120 Shenandoah Road Toledo, Ohio	William B. Davis JEfferson 6-7947

WESTERN SALES MANAGER

John R. Morrison

McDonald-Thompson Offices

Los Angeles 5, Calif. 3727 West Sixth Street	Connie J. Grabb DUnkirk 7-5391
Seattle 4, Wash. 1008 Western Ave.	Harry Abney MAin 3-3766
San Francisco 5, Calif. 625 Market St.	Les Meek YUkon 6-0647
Denver 2, Colo. 222 Colo. National Bank Bldg.	Robert Heidersbach KEystone 4-4669
Houston 6, Texas Room 214, 3217 Montrose Blvd.	Frank Vickrey JAckson 9-6711
Tulsa, Okla. 2010 South Utica	Ted R. Trautman Riverside 3-1981

Change of Address: Send to POWER ENGINEERING, Circulation Division, Barrington, Illinois. Please supply your position title, company name, company address. Request must reach us by 15th of month to make the change effective with the following month's issue.

Subscription Information: Published monthly; price in U.S. and possessions $10 per year; in Canada $11 per year; other countries $12 per year; single copies $1.

Indexed in the Industrial Arts Index and the Engineering Index on file in public and many private libraries

Microfilm editions: Request prices from University Microfilms Inc. Ann Arbor, Mich. All volumes since 1948

Copyright 1958 by Technical Publishing Co., Barrington, Illinois. Accepted as controlled circulation publication at Concord, New Hampshire.

PUBLISHED SINCE 1896 FOR POWER ENGINEERS IN PRIVATE AND PUBLIC UTILITIES AND INDUSTRIAL PLANTS

ENGINEERS' PREVIEW

NEW INSTRUMENT that uses two beams of light to solve the difficult problem of inspection of turbine engine blading has been developed by Eastman Kodak's Apparatus and Optical Division. It's called the Kodak Section-Profile Projector and permits viewing of an entire section of a compressor blade, vane, turbine bucket, or half of a forging die. With some training, an operator can rapidly measure dimensions of such parts to within five ten-thousandths of an inch as well as twist to five minutes of arc.

In designing the projector, Kodak has had chiefly in mind the blades in jet engines, but the instrument is expected to have uses in other engineering fields.

DIESEL engine standard practices are covered in 1958 Diesel Standard Practices for Low and Medium Speed Diesel and Gas Engines. This is the fifth edition of a reference work first published in 1930. It's available from the Diesel Engine Manufacturers Assn, 2000 K St, Washington 6, D. C., at $5 a copy.

NEW TECHNIQUE pioneered by the American Society of Tool Engineers in putting on its Western Tool Show in Los Angeles, Sept 29 to Oct 3, was a "charge plate" system. When a visitor to an exhibitor's booth wanted more information, a follow-up call, etc, he simply presented a small metal plate on which his name, address, title and company were embossed. By quick stamping of this information from plate to a standardized card, the exhibitor eliminated illegible hand-written requests, incomplete data, misplaced calling cards. Fittingly enough, the device is called an Inquiry Time-Saver.

Whether the charge-plate idea was responsible or not, ASTE's show rolled up on-the-spot sales of $4,000,000 in addition to thousands of inquiries. There was even one $500,000 sale, by the True-Trace Corp to Bridgeport Machines, Inc. Total attendance was 11,627.

FIRST industrial customer for electricity from the St. Lawrence project of the Port Authority of the State of New York has turned out to be the Massena works of the Aluminum Co of America. With this new source of hydroelectric power, Alcoa is closing its nearby Grasse River generating station, which has been a major supplier of Massena energy since 1903.

FORMULA to tell industry how much money can profitably be spent on research is part of a long-term study now underway at Case Institute of Technology, under sponsorship of the National Science Foundation.

In establishing the formula, data for several recent years are being collected from individual companies, and include records of financial performance as well as research expenditures over a period of several years. Also included are non-controllable variables that affect a company's profits.

Mathematical development of the formula will be aimed at computing those variables which increase the company's overall profits. Detecting significant changes in variables beyond the company's control can be used in adjusting the mathematical solution to the problem, affecting those variables which the company itself can control.

1959 NUCLEAR CONGRESS will be held at the Cleveland Auditorium, April 5–9, 1959.

1959 American Power Conference will be held in Chicago, March 31 through April 2. This will be the 21st annual meeting.

FOSTER WHEELER Corp has received a contract to construct one of the largest surface condensers ever built. Unit is a 210,000 sq ft, single pass, twin surface steam condenser for Commonwealth Edison Company's Crawford Station in Chicago. The condenser will be mounted at

the turbine floor level to serve a side-exhaust, cross-compound, 325,000-kw (nameplate) turbine.

The unit includes an improved design for reverse cooling water flow in a single pass condenser making use of 72-in. external pipes and a special valve arrangement.

MOST comprehensive study of engineering salaries ever made in the U. S. is now being completed by Engineers Joint Council. The final report to be published this year-end will be substantially expanded over the 1956 survey, with over 650 participating organizations. It will contain data broken down into some twenty industrial activities, various levels of government, and engineering education. Price of the report will be $3.

AUTOMATION, what does it mean to power production? Jeff Hunnicutt, an associate editor of POWER ENGINEERING, spoke on this theme recently before an engineering society in North Carolina.

Hunnicutt speaks in N. C.

Hunnicutt points out that with a national living standard rising at an annual rate of 2.7 per cent and promising to result in a gross national product of $858 billion within 20 years, any shortening of the work week just isn't in the cards. In addition, factory automation must grow dramatically within this span. As automation grows, so must our production of electric energy. Hunnicutt predicts that electric utility generating capacity must more than quadruple in the next 20 years, if our present rate of rise in living standards is to be supported.

CLEAVER-BROOKS CO, manufacturer of packaged boilers, has acquired the 68-year-old Springfield Boiler Co. The transaction required $500,000 for purchase of the business, and $500,000 to cover working capital requirements. The purchase extends C-B product lines up to 50,000 lb of steam an hour on packaged boilers and up to 300,000 lb on field-erected units.

NATIONAL ENGINEER'S WEEK for 1959 is set for February 22–28. National Society of Professional Engineers, 2029 K Street, NW, Washington, D. C., has various promotional aids available. Among them is a set of one-minute TV films presenting the theme "Engineering for the Space Age." Each film qualifies for public service during TV station breaks. The set of five is available at a cost of $25. Order now.

FIGHT against air pollution has been going on for a long time. Arnold Arch, president of the Air Pollution Control Assn, reminds us that the first specific regulation of air pollution was in England in the latter part of the 14th century.

A law was enacted that all persons burning "sea cole" should, on the first offense, have their furnaces destroyed. A man who persisted in the error of his ways was to have his head cut off.

Today in this country close to 10,000 communities have air pollution problems. Arch estimates that on any given day, the use of air pollution control devices is preventing the escape of about 50,000 tons of man-made dirt. Sales of such equipment have averaged an estimated $500,000,000 a year for the last five years, Arch states.

HONORS and anniversaries: AIEE's highest grade — that of Fellow — has been awarded to Ernest A. Johnson, vice president in charge of engineering, Southern New England Telephone Co; Corbett McLean, supervisor, engineering division, Pacific Power and Light Co; and to David E. Trucksess, power development engineer, Bell Telephone Laboratories.

Kurt F. Wendt, dean of the University of Wisconsin's College of Engineering, has been appointed a member of the National Research Council.

Donald C. Burnham, vice president in charge of manufacturing for Westinghouse, has won ASME's Richards Memorial Award for achievement by a young mechanical engineer. Burnham is a 1936 graduate of Purdue University.

Yarnall-Waring Co of Philadelphia is celebrating its golden anniversary. Founders Bernard G. Waring and D. Robert Yarnall are now honorary chairman and chairman of the board, respectively. As part of the celebration, Yarway's president Frank W. Miller announced a scholarship award program for children of the company's employees. It provides $600 per academic year, renewable up to four or five years, for annual winners seeking a bachelor's degree at accredited colleges or universities.

TVA is celebrating its 25th birthday. The Agency has now become the nation's largest electric power utility, with a generating capacity of 10,200,000 kw, 75 per cent of it from steam plants. To fuel its steam generating plants, TVA now purchases over $80,000,000 worth of coal a year. Its low power rate — 1.2 cents per kwh as compared to 2.6 cents for the national average — has boosted the valley's household use of electricity to over twice the national average. American taxpayers have invested some $1,500,000,000 in TVA over its 25 years, and the Agency claims an average "return" on this investment of about 4 per cent a year.

CANADIAN NATIONAL COMMITTEE, World Power Conference, advises that a number of copies of preprints of technical papers and general reports printed in connection with the recent Canadian Sectional Meeting are still available. Detailed report of that meeting was given in the November, 1958 issue of POWER ENGINEERING.

These preprints may be purchased at a cost of 1 cent (Canadian) per page. Cost of a complete set of papers and general reports is $28 (Canadian). Send orders direct to T. M. Patterson, Honorary Secretary, Canadian National Committee, World Power Conference, 150 Wellington St, Room 500, Ottawa 4, Ontario, Canada.

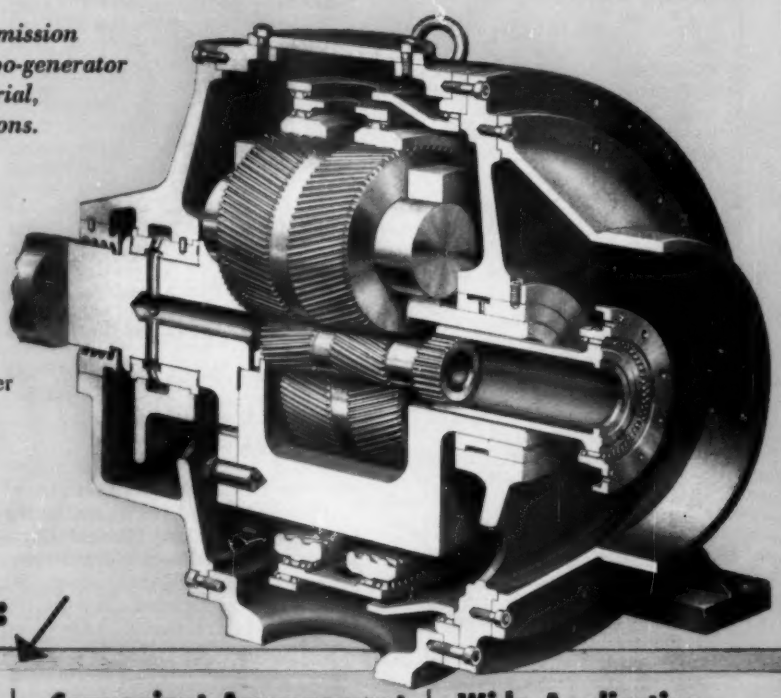
DE LAVAL-STOECKICHT
PLANETARY GEAR

...for high speeds...high horsepower

Proved in hundreds of installations abroad totalling over 3,000,000 horsepower—now available in America!

For all high torque power transmission applications such as pump turbo-generator and compressor drives in industrial, municipal and marine installations.

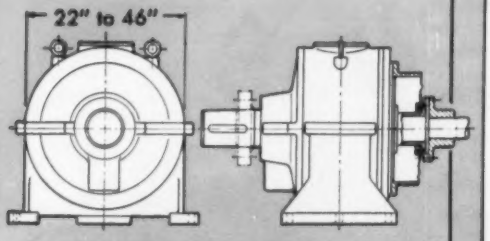
This cutaway view of the De Laval-Stoeckicht Planetary Gear shows how it provides flexibility for proper load distribution throughout the gear members. The thoroughly proved and tested design is completely reliable in transmitting high horsepower for high speed applications. • Highest efficiencies (98% or higher)...no high speed bearings...less friction losses.



Check These Advantages:

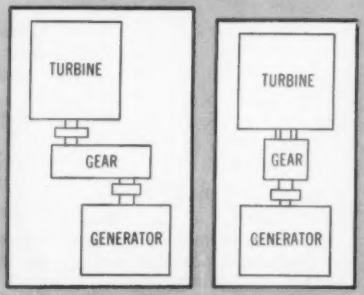
Small Size—Light Weight

Compact—low weight per hp. Sizes range from 22" to 46" in diameter, depending on horsepower requirements. Example: 5000 hp planetary unit weighs 1700 lbs. against 6000 lbs. for conventional gear.



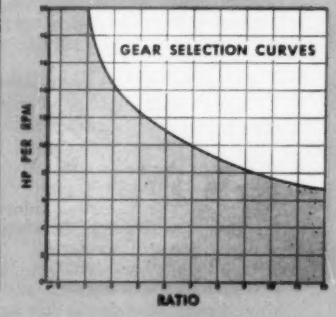
Convenient Arrangement

Co-axial or "in-line" arrangement of gear members takes up far less space than parallel axis gears of equivalent horsepower rating.



Wide Application

Capacity range shown in shaded area on chart below. For other applications, contact your De Laval Sales Engineer.



For further details, write for Bulletin 2400.

DE LAVAL *Steam Turbine Company*

816 Nottingham Way, Trenton 2, New Jersey

WHAT THEY TELL US

▶ **PUMPS IN PARALLEL,** and how system changes affect their operation, was the subject of an article by Paul N. Garay in the April issue. T. M. Reynolds, Jr, test engineer for the Ohio Power Co, Muskingum River Generating Div, writes:

> We would like 12 copies of this article for our engineering department. We feel that this article makes a very fine reference when analyzing pump tests. May your magazine continue its fine presentation of technical articles.

▶ **PROS AND CONS** of this department's fly-ash reinjection controversy have drawn this commentary from Lawrence M. Larson, chief engineer of American Motors Corp's Milwaukee body plant:

> I was much interested in the pros and cons of fly-ash reinjection in the July and September issues of POWER ENGINEERING, and especially in Mr. Churchill's comments.
>
> We have been operating a spreader stoker-fired boiler of 100,000 lb per hr capacity, with 100 per cent return of fly-ash (carbon), for six years. In our unit, the fly carbon is collected from the last pass and economizer hoppers, as well as from the collectors, all piped to a common hopper and returned by gravity onto the quiet zone of the traveling grate at the rear water-wall header, then traveling the entire length of the furnace before being deposited in the ash hopper with the other ash.
>
> The fly carbon is all burned by the time it reaches the ash hopper, as many samplings indicate there is very little carbon in the total ash.
>
> In many installations, the fly carbon is blown into the furnace, then most of it is re-circulated again, aggravating the dust loading of the furnace.
>
> An extensive test of the boiler unit by a competent group of engineers has shown that the average dust loading of the stack gases is 0.542 lb per 1000 lb of flue gases (corrected to 12 per cent CO_2) — this with 100 per cent reinjection. Legal requirements are not over 0.85 lb per 1000 lb of flue gases.
>
> Incidentally, this boiler unit does not have any soot blowers, and at no time during shut-downs has any excessive amount of fly ash or soot been found lodged in any part of the setting.
>
> From observation, I would estimate that the fly carbon returned onto the grate amounts to from 2 to 5 per cent by weight of the fuel burned, depending on the fineness of the coal burned, and if this fly carbon were discarded, as suggested by Mr. Gesell, it would be a direct loss. Following is an analysis of a representative sample of fly carbon taken from the return pipes of the last pass and economizer hoppers: moisture, 0.10; volatile, 1.48; fixed carbon, 53.39; ash, 45.03; Btu, 5617.
>
> In conclusion, we don't have a fly-ash disposal problem, and were there no other benefits due to reinjection, than the elimination of the disposal problem, I would still handle the fly ash or carbon the way we do. At present we are burning W. Va. splint coal, 1-in. by 100 mesh, at an efficiency of 87–88 per cent. We have also burned Illinois bug-dust during a test run, also with 100 per cent return of fly carbon, and with good results.
>
> The ash-hauling contractor, who uses this ash for fill, is well satisfied with the grade of ash.

▶ **HIGH COST** of nuclear power was the burden of a statement of S. B. Roboff, director of marketing for Sylvania-Corning Nuclear Corp, published in our Preview department recently. Roboff said that nuclear fuel costs must be reduced "200 to 300 per cent" before nuclear power can become competitive. Reaction to this statement, from reader Lawrence A. Teasdale of New Haven, Conn., was as follows:

> Assuming the original cost of the fuel was 100 per cent, what have you got when you reduce it 300 per cent? Reductions of 20 per cent, 30 per cent or 99.9 per cent I can see, but 300 per cent . . .!

Strictly speaking, Reader Teasdale is right. What Roboff meant was that the fuel cost must be reduced to one-half or to one-third of today's costs before nuclear power can become competitive.

▶ **JOHN PHELPS,** engineer in the University of California's Office of Architects and Engineers, wrote us the other day for certain information, and commented:

> I have been reading POWER ENGINEERING for several years and find its articles very helpful, both from the practical standpoint and also to enable me to keep up with recent developments.

▶ **ROUNDING UP** a group of outstanding high school and junior college graduates for 1958, the Chicago Daily *News* asked, What will you be doing when you're 40? Replied John Nielsen, 25-year-old graduate from Wilson Junior College:

> When I'm 40 I expect to be earning $15,000 a year, allowing for inflation, with a responsible position in power engineering. I'll be active in local civic groups, maybe in politics.

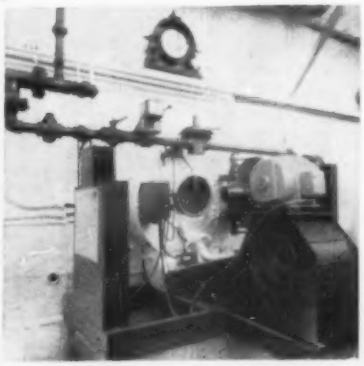
▶ **CONVERSION** from coal firing (pneumatic stokers) to fully automatic gas-or-oil has resulted in higher efficiency and operating economies in heating for the Roots-Connersville Blower Division's (Dresser Industries) plant in Connersville, Ind. A new building, 420 by 100 ft, was to be added, putting an increased demand on the heating plant (two Springfield boilers, each 400 bhp and fired alternately).

C. A. Wilson, in charge of the plant, figured that the new load could be satisfied by converting one of the boilers to gas-or-oil firing, and heating plant costs cut at the same time, in spite of anticipated higher fuel bills. He was right.

In November, 1956, an Iron Fireman RC-FA combination burner was installed on one of the boilers at a total conversion cost of $12,000. Ohio Valley Gas Co provided gas on an interruptible rate basis (so far interrupted only once). Boiler hp was increased to a calculated 575.

Analyzing the figures, Wilson says:

> In 1954, it cost $33,000 to operate the heating plant, of which $17,000 was in wages — one man, three shifts. Conversion eliminated heating plant salaries, although fuel was higher.
>
> Calculated on the basis of gas, the old load would have taken 37,000,000 cu ft. New load actually took 55,800,000 cu ft. Cost of the old load, on gas, would have been $27,740. Cost of the first year of operation, with conversion burner satisfying the increased demand, was $33,500.



Roots-Connersville's conversion burner

Maintenance and Steam Traps

. . . there's a relationship that goes far beyond trap maintenance alone

Good traps and good trapping have a greater effect on your maintenance costs than does trap maintenance itself. By that we mean that the right traps, properly selected and installed, and with the benefits of a preventive maintenance program, will save far more maintenance dollars than they will cost.

Under the pressure of spiralling maintenance costs, this thought becomes mighty important. Let's take a look at what it involves:

Proper Selection of Steam Traps

1. Be sure it's the right type of trap.

2. Be sure it's sized right and is for the correct operating pressure.

3. Be sure it's first rate in design and construction.

Proper Installation of Steam Traps

1. Install them so they are accessible for inspection and maintenance.

2. Install a test valve.

3. Use a union or unions.

4. Use a shutoff valve or valves.

5. Use a strainer ahead of the trap if dirt conditions are bad.

6. Use a by-pass only where continuity of service is imperative.

7. Standardize inlet and outlet connections.

Preventive Maintenance Program

1. Test trap regularly for proper operation. (Trap size, operating pressure and importance determine frequency.)

2. Inspect internal mechanism at least once a year.

You Get Indirect Benefits As Well

The direct benefits of the plan outlined are pretty obvious — good traps, properly selected, require less maintenance . . . testing and inspection prevents troubles that lead to maintenance.

However, this plan provides indirect benefits which reduce maintenance in other parts of the plant as well:

Good traps save steam and reduce the load (and consequently maintenance) on fuel handling and burning equipment and on ash handling equipment.

Good traps protect the system by eliminating water hammer and preventing the damage it can do.

Good traps discharge carbon dioxide before it can go into solution to form corrosive carbonic acid — less corrosion, less maintenance.

Good traps increase production to reduce the length of time equipment must operate or reduce the amount of equipment needed . . . either way maintenance is reduced.

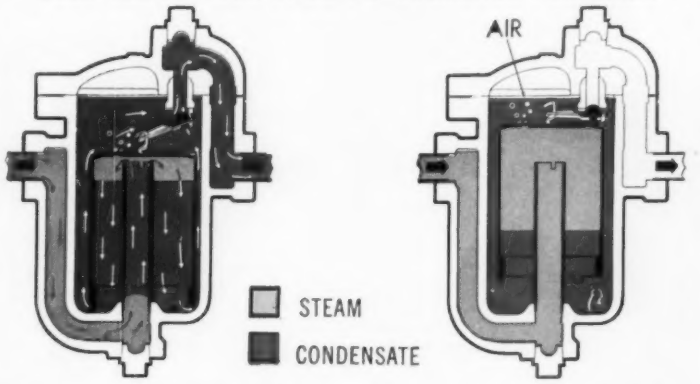
How to Go About It (The Sales Pitch)

We admit we're prejudiced, but we don't think there is any better way to select steam traps than with the help of the 44 page Armstrong Steam Trap Book. Here in a single source is specific data on the selection and sizing of traps, how to install them for best results, and how to maintain them most economically.

The Steam Trap Book will also give you full information on the design and construction of Armstrong Inverted Bucket Steam Traps that offer these important maintenance-reducing advantages:

1. Armstrong Traps are dependable.

HERE'S THE STEAM TRAP DESIGN THAT CAN REDUCE YOUR MAINTENANCE PROBLEMS



Trap open. Condensate entering trap has caused bucket to lose buoyancy. Weight of bucket times leverage pulls valve open. Air is discharged along with condensate.

Trap closed. Steam has floated inverted bucket; valve is held tightly closed by system pressure. Air entering trap passes through bucket vent and accumulates at top of trap.

2. Armstrong Traps require no adjustments — go from full load to zero load automatically.

3. Armstrong Traps are self-scrubbing—ordinary dirt conditions can't hurt them.

4. Armstrong Traps have long-life parts — valve and seat are heat treated chrome steel — lever assembly and bucket are stainless steel.

5. Armstrong Traps have water sealed valves to minimize wire drawing and erosion.

Ask for your copy of the Steam Trap Book—there is no obligation. Then test Armstrong Trapping. If you are not completely satisfied with the results, you can return the traps for a full refund of the purchase price. You can't lose much that way. Call your local Armstrong Representative or Distributor, or write

Armstrong Machine Works
8108 Maple Street
Three Rivers, Michigan

ARMSTRONG STEAM TRAPS

For more data circle 505 on Post Card

here is what you need for *better* BOILER WATER LEVEL INDICATION!

YARWAY REMOTE LIQUID LEVEL INDICATORS

Boiler water levels and other liquid levels requiring remote indication can be handled completely by a Yarway system.

Heart of the system is the Yarway Remote Liquid Level Indicator that gives instant, accurate readings because the mechanism is operated by the boiler water or other liquid itself. The pointer mechanism is never under pressure. Clear, "wide vision" face permits easy readings from any angle.

The Yarway Indicator conforms with A.S.M.E. Boiler Code Committee ruling (Case #1155) permitting two independent remote level indicators of compensated manometric type to replace one of two required gage glasses for boiler pressures 900 psi and above.

Electronic Secondary Indicators can be added at any point in the plant. Remote Hi-Lo Alarm Signals (lights and/or horns) can be connected for additional safety.

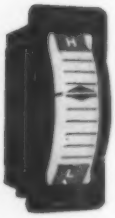
Primary indicators fully compensated for every pressure change in boiler also available.

For permanent record of changing levels, the Yarway Hi-Lo-Graph Recorder can be furnished.

Over 12,000 Yarway Remote Indicators have already been installed. For full details, write for Yarway Bulletin WG-1824.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
Branch Offices in Principal Cities

FULLY COMPENSATED INDICATORS



for completely accurate indication under every boiler operating condition.

ELECTRONIC SECONDARY INDICATORS

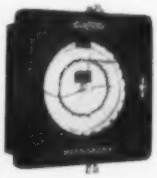
To supply additional indication at any point without pressure connections.

REMOTE SIGNALS

Hi-Lo Alarms. Lights and/or Horns.

RECORDERS

To provide permanent 24-hour record of liquid levels.



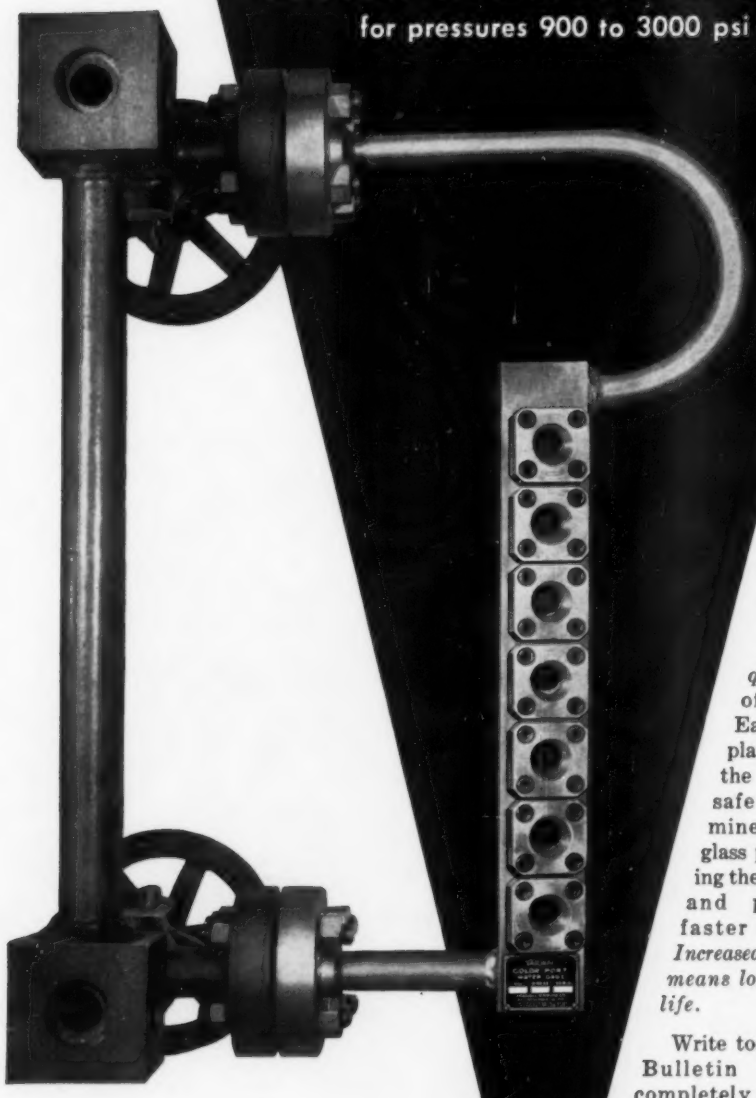
YARWAY

. . . a good way to specify remote liquid level indicators

COLOR-PORT

BOILER WATER LEVEL GAGE

for pressures 900 to 3000 psi

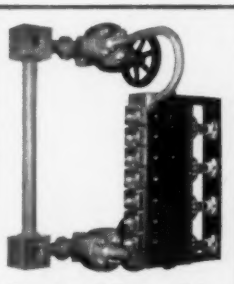


- *two-color readings!*
- *reduced maintenance!*
- *increased availability!*

Now Yarway offers brilliant two-color boiler water level readings, combined with simplicity of gage maintenance and increased availability.

With the new Yarway Color-Port Gage, water space shows green, steam space shows red. A full gage is all green and an empty gage all red.

The Color-Port Gage is *serviced quickly in place* by simple replacement of individual cover-glass assemblies. Each cover assembly is held solidly in place by four socket head capscrews and the "floating assembly" design applies safe predetermined loads on glass ports, reducing thermal shocks, and permitting faster warm-up. *Increased availability means longer service life.*



Side view of Yarway Color-Port Water Level Gage with illuminator, circulating tie-bar and Welbond gage valves.

Write today for new Bulletin WG-1814, completely describing Yarway Color-Port High Pressure Water Level Gages.

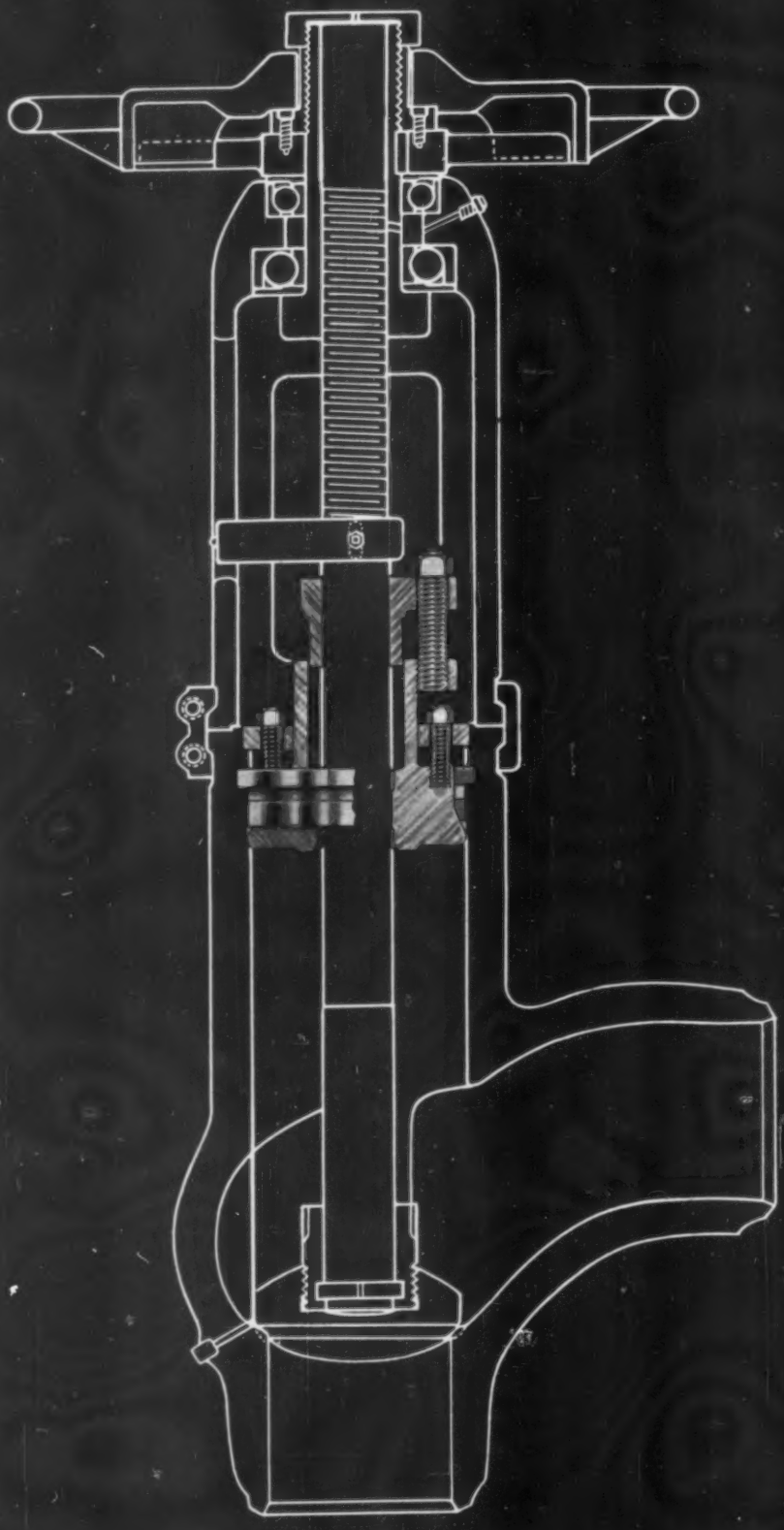
YARNALL-WARING COMPANY

100 Mermaid Avenue, Philadelphia 18, Penna.

BRANCH OFFICES IN PRINCIPAL CITIES.

YARWAY COLOR-PORT ... *a good way to specify high pressure water gages*

For more data circle 506 on Post Card



EDWARD PRESSURE-SEAL ANGLE VALVE

What's New from Edward Valves

New Products . . . Problems and Solutions. . . Information on Steel Valves from Edward, Long-Time Leader in the Field!

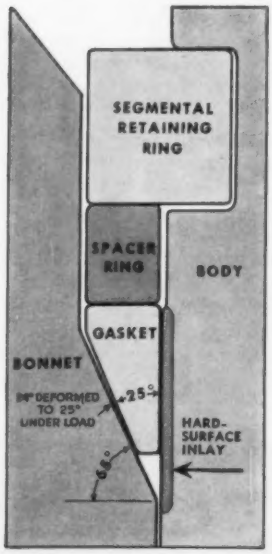
Not A Single Failure Reported In 5 Years

on unique "Pressure-Seal" body-bonnet joint!*

Advances in service temperatures (above 800 F) led to introduction, in 1945, of commercial steel valves with pressure-seal bonnet joint construction. These superseded bolted joint valves of earlier design.

The original 45° pressure-seal gasket, used by Edward and other manufacturers, was a significant improvement in minimizing leakage. But scientists in the Edward Research Laboratories refused to accept this as the best that could be done, set out to develop a better pressure seal joint.

In 1953 Edward research paid off: a completely new Edward pressure-seal design—with 25°–65° joint—was introduced. Design is shown in diagram on this page. The change in gasket angle, plus other Edward improvements described here, brought an end to bonnet joint leakage in pressure-seal valves.



Literally thousands of Edward pressure-seal valves have been installed since 1953 in a great variety of services. Of these, *not a single case of failure has ever been reported.*

Here's Why Edward Improved "Pressure-Seal" Succeeded:

SEALING AREA MULTIPLIED!
Improved gasket design *triples* sealing surface area, virtually eliminates possibility of leakage.

SEALING FORCE DOUBLED!
Angular relationship of bonnet, gasket and body directs more line load *outward* against the gasket, doubles sealing force.

SPECIAL GASKET SEAL-COATING!
A special corrosion-resistant malleable coating (.001 inch thick) is applied to gasket, flows into minute irregularities, assures perfect seal.

IMPROVED BODY SEALING SURFACE!
Possibility of any microscopic casting porosity in vital body-gasket sealing zone is avoided by inlay of corrosion resistant hard-surfacing material.

EASY DISASSEMBLY!
Body bore has been enlarged just above gasket area; this permits gasket to be easily lifted out, after segmental retaining ring and spacer are removed.

GASKET DAMAGE ELIMINATED!
Sharp edge of gasket has been rounded-off, eliminates possible damage to gasket during handling or storage.

EDWARD VALVES, INC.
1230 West 145th Street, East Chicago, Indiana
Subsidiary of
ROCKWELL MANUFACTURING COMPANY

Represented in Canada by
LYTLE ENGINEERING SPECIALTIES, LTD., 360 Notre Dame St. W., Montreal 1, Que.

Edward builds a complete line of forged and cast steel valves from ¼" to 18"; in globe and angle stop, gate, non-return, check, blow-off, stop-check, relief, hydraulic, gage and special designs; for pressures up to 10,000 lbs; with pressure-seal, bolted, union or welded bonnets; with screwed, welding or flanged ends.

*T. M. Reg. U. S. Pat Off.

For more data circle 507 on Post Card

When a motor we installed single phased, — Fusetron Fuses saved our reputation and a $200 rewind job

C. B. Meldrum, OWNER
MELDRUM ELECTRIC COMPANY
HOUSTON, TEXAS

Mr. Meldrum continues:

"Recently I sent several of my men to install a 50 h. p. air conditioning unit for a customer.

"It seems that my man who wired the 200 amp. switch failed to tighten a lug. He just hung the wire on the lug and then forgot to tighten it.

"When the unit was started, it didn't take long for trouble to develop. The loose connection caused one Fusetron fuse to blow. The motor started to run single phased but before any damage could result the other Fusetron fuses protecting the motor also blew and shut down the motor.

"My company stands behind its work. If the motor would have burned up, we would have rewound it without question. I know this would have cost us at least $200.

"What is important too, our reputation was saved and we have a satisfied customer. If the Fusetron fuses had not given us an opportunity to go back and do the job right before the motor was damaged, we would have been in a 'hot' spot."

For safe, modern, money-saving protection install FUSETRON dual-element FUSES and BUSS Hi-Cap FUSES throughout entire Electrical System!

Why Fusetron Fuses Provide Safest, Simplest Way to Prevent Damage from Single Phasing

When single phasing occurs, the current in the remaining phase increases about 100%. (Theoretically 73% but change in efficiency and power factor makes it about 100%.

This 100% overload on Fusetron fuses of motor-running protection size opens them and shuts down the motor.

Such dependable protection against motor burnouts from single phasing has never before been available.

You too, Can Get Safer, More Dependable and Money-Saving Protection with Fusetron Fuses

FUSETRON dual-element fuses provide 10 point protection against electrical troubles. This is unlike circuit breakers or ordinary fuses which, except in rare cases, protect only against short-circuits.

In Addition: Fusetron Fuses Require No Maintenance or Recalibration

They are calibrated at the factory by engineers. Once properly installed, they require no inspection or down-time necessary on mechanically operated devices. There are no hinges, pivots or contacts to stick or get out of order. Dust, corrosion or oxidation cannot increase a Fusetron fuse's capacity or lengthen its blowing time.

After years of inactivity, a Fusetron fuse will give the same safe, dependable protection if called upon to open as it would have on the day it was installed.

For Loads above 600 and up to 5,000 amps . . . Use BUSS Hi-Cap Fuses

They have an interrupting capacity sufficient to handle any fault current regardless of system growth.

They can be coordinated with Fusetron fuses on feeder and branch circuits to limit fault outages to circuit of origin.

for more information, write for . . . **Bulletin FIS on Fusetron fuses**
Bulletin HCS on BUSS Hi-Cap fuses.

BUSSMANN MFG. DIVISION - McGraw-Edison Co. *University at Jefferson, St. Louis 7, Mo.*

FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS
McGRAW EDISON
BUSSMANN MFG. DIVISION · St. Louis 7, Mo.

For more data circle 508 on Post Card

You too
can buy with confidence from ERIE CITY

● Erie City . . . pioneer in the development of the 2-drum boiler and the application of water walls to furnace design . . . offers a complete modern line of 2-drum steam generators to solve your most complex steam problems.

Installations such as shown here indicate the versatility and acceptance of the Erie City 2-Drum Steam Generator. The wide range of sizes adapted to all types of mechanical firing prove the adaptability of Erie boilers to all classes of industry. The broad experience of Erie City qualifies it to combine proper boiler selection with efficient use of modern heat recovery equipment and proper application of firing equipment. Add to this the fact that Erie City Generators are designed to include the best of modern utility standards and then you know "*You can depend on Erie City for sound engineering*" . . . is not just a statement. It is a positive fact that will prove to be of value and profit to you.

Write for new general catalog SB-508-2M.

ERIE CITY
Since 1840

Some of the Many Users of

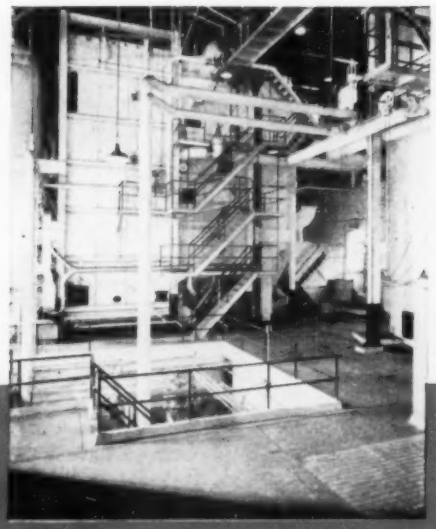
ERIE CITY 2-DRUM STEAM GENERATORS

Allied Chemical & Dye Corp.
American Cyanamid Co.
American Steel & Wire Division of U. S. Steel Corp.
Armour & Co.
Ashland Oil & Refining Co.
Continental Motors Co.
Great Western Sugar Co.
International Business Machines Corp.
The Texas Company
Dierks Paper Company
Johns-Manville Corporation
Ford Motor Co.
Gulf Oil Corporation
Hercules Powder Co.
LeTourneau Westinghouse Co.
Minnesota Mining & Manufacturing Co.
Monsanto Chemical Co.
Northern Chemical Industries, Inc.
Northwestern University
Ohio State University
Olin Mathieson Chemical Corp.
Tidewater Associated Oil Co.
U. S. Atomic Energy Commission
Woodward Iron Co.

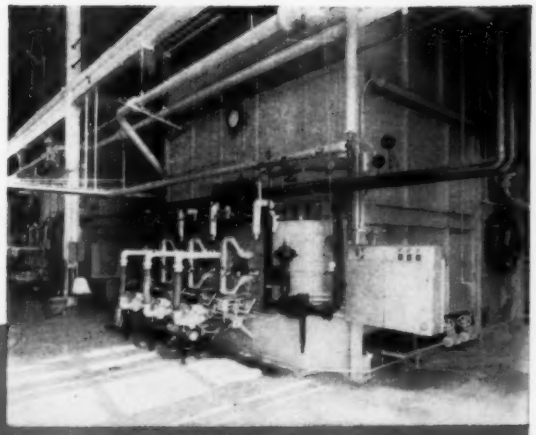
You can depend on Erie City for sound engineering

ERIE CITY IRON WORKS · Erie, Pa.

STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS
WASTE HEAT BOILERS • FIRE and WATER TUBE PACKAGE BOILERS
OIL and GAS BURNERS • STOKERS • PULVERIZERS



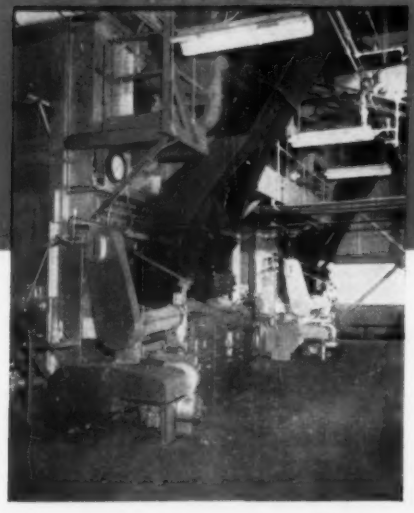
2—150,000 #/hr. Erie City 2-drum Steam Generators, stoker fired, at GREAT WESTERN SUGAR CO., Longmont, Colorado



2—70,000 #/hr. Erie City 2-drum Steam Generators, oil and gas fired, at INTERNATIONAL BUSINESS MACHINES CORP., Rochester, Minnesota

1—150,000 #/hr. Erie City 2-drum Steam Generator, oil and gas fired in a pressurized furnace, at THE TEXAS CO., Lockport, Illinois

2—65,000 #/hr. Erie City 2-drum Steam Generators, stoker fired with coal and wood waste, at JOHNS-MANVILLE PRODUCTS CORP., Klamath Falls, Oregon



1—50,000 #/hr. Erie City 2-drum Steam Generator, gas fired, at DIERKS PAPER CO., Pine Bluff, Arkansas

For more data circle 509 on Post Card

Steel stack and breeching being gun-lined with refractory concrete (made with LUMNITE calcium-aluminate cement) at United Illuminating Company, New Haven, Conn. Gunite Contractor: Pressure Concrete Co., Newark, N. J.

ATLAS LUMNITE in stack linings . . . protects steel shell from corrosion and heat

- Refractory concrete linings (made with ATLAS* LUMNITE cement) resist the corrosive action of flue-gas condensate which forms on stack surfaces.
- Concrete retains high strength under continued exposure to heat and frequent heating-cooling cycles.
- Placement is fast, easy, economical – by guniting, pouring or plastering.
- Downtime is reduced because concrete reaches service strength in 24 hours.

For maximum convenience, use castables made with LUMNITE* cement. These are packaged mixtures, ready for use. Simply add water, mix and place. Made and distributed by leading manufacturers of refractories.

Write for "Lumnite Mortar Manual," describing gun-applied linings: Universal Atlas, 100 Park Avenue, New York 17, N. Y.

L-175

UNIVERSAL ATLAS CEMENTS

Universal Atlas Cement
Division of United States Steel

USS * TRADE MARK

OFFICES: *Albany · Birmingham · Boston · Chicago · Dayton · Kansas City · Milwaukee · Minneapolis · New York · Philadelphia · Pittsburgh · St. Louis · Waco*

For more data circle 510 on Post Card

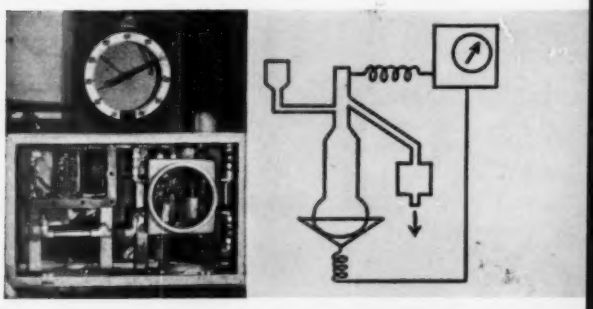
Nothing gets by

Automatic end-point testing device developed by Standard Oil research men makes certain of the uniform quality of gasoline and diesel fuel delivered to you.

Scientists at Standard Oil never stop in their drive to improve and then improve again the uniform quality of the petroleum products that bear the Standard Oil trade-mark. These engineering research scientists have now created wholly new instruments for performing near continuous physical analysis *automatically*.

One such instrument automatically performs the physical analysis that determines end-point. Using it, refineries maintain a continuous inspection of the temperature at which diesel fuels are completely distilled. To you, this means that Standard is able to maintain a constant control over the uniformity and high quality of the fuels you use to power your diesel engines. It also means that Standard Oil power-producing petroleum products, with their constantly controlled end-point, burn uniformly, give you uniform high performance.

This is part of the research pay-out, the "something more" research builds into the products you buy from Standard. This is your return from Standard's investment in research. And now there are 48 district offices in the 15 Midwest and Rocky Mountain states to serve you. Call the one nearest you. **Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.**



Automatic end-point tester works this way. A small sample is placed in an electrically heated flask. The temperature is measured and recorded during a heating cycle when distillation is accomplished. Distillate is condensed and drained, the flask temperature is lowered by introduction of the next sample, and the apparatus is ready for another test.

You expect more from STANDARD and get it!

A REPORT:

This is growth . . .
healthy growth . . . and a
credit to the power industry.

For the past half-century, the Duke Power Company has been serving the Piedmont Carolinas. Today this utility, covering a 20,000 square mile area, has 7 steam and 32 hydro-electric plants with a generating capacity of nearly 2¾ million kilowatts . . . 12 billion kilowatt hours a year. More than ½ million customers are being supplied with instant, dependable power for light, protection and comfort . . . reliable power for successful farming and progressive industry. And the Duke Power Company is expanding rapidly. New units are being constructed constantly. An investment of about $30,000,000. annually goes into this expansion program to service a fast growing area.

Every one of the present 39 power stations now operating this system was designed, constructed and developed by the Duke Power Company engineers. Each plant has been kept modern in every respect. And every one of these stations uses Chapman Valves. Chapman Valves have been used by this system since the turn of the Twentieth Century. They have been used for many sound and practical reasons.

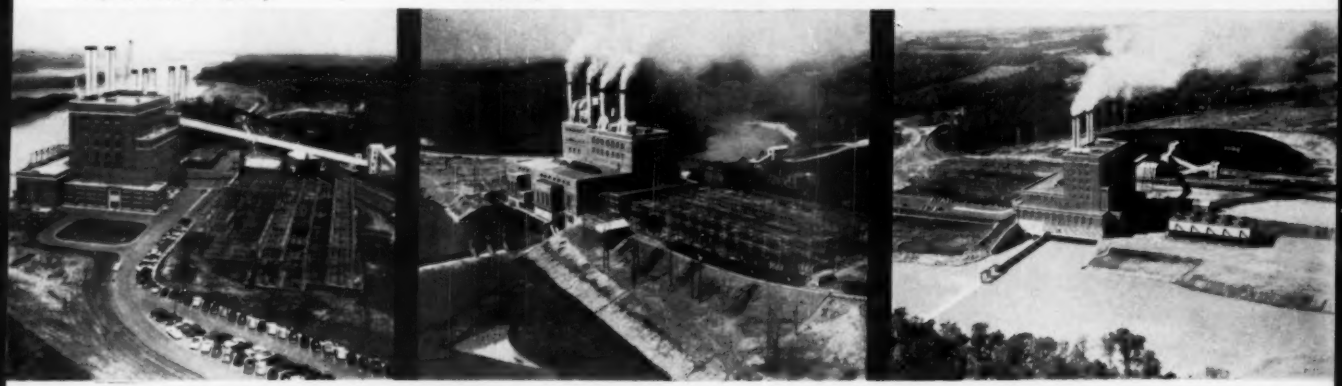
Chapman steel valve . . . 16" x 14" x 16" . . . pressure seal type, 1500 lb. series. Chapman is constantly supplying growing industries with valves for increasingly high pressure and temperature service.

on the Duke Power Company and Chapman Valves

Above: Cliffside units 1, 2, 3, 4. Total kilowatt capacity 220,000.
Below: Buck units 1, 2, 3, 4, 5, 6. 460,000 kilowatt capacity.

Above: Riverbend units 1-7 with a total capacity of 665,000 kilowatts.
Below: Dan River units 1, 2 and 3. 300,000 kilowatts total capacity.

Above: Allen Steam Plant — Two additional units now under construction.
Below: Lee units 1 and 2. 385,000 kilowatts. Unit 3 opens December 1958.



The CHAPMAN VALVE

Manufacturing Company INDIAN ORCHARD, MASSACHUSETTS

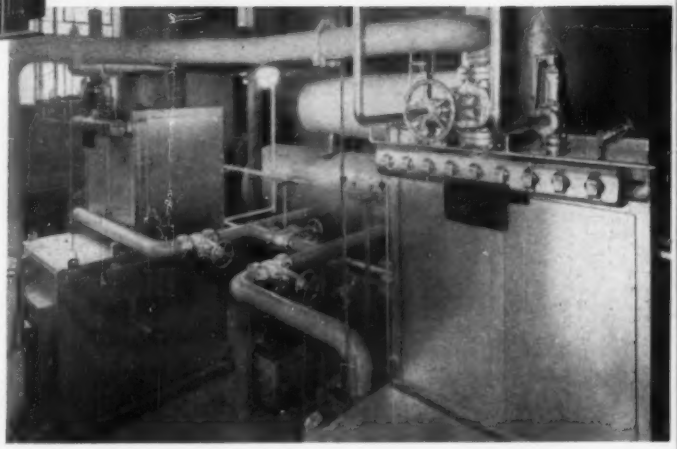
Study the record of The Chapman Valve Manufacturing Company for the past 75 years and you'll find the many reasons why Chapman Valves are used by Duke Power and many other important Companies in many fields of endeavor. Chapman designs, develops, produces and delivers valves — that meet the requirements of today and of tomorrow. A consultation between Chapman engineers and yours, with no obligation to you, is sincerely recommended. Simply write . . . today, anytime, soon.

For more data circle 512 on Post Card

In new plants large and small...

The C-E high temperature water boiler offers savings of 10 to 20%

Shop assembly view showing steel frame and pressure parts for 25-million Btu unit prior to installation of refractory, insulation block, and welded gastight casing.



Compactness of C-E HCC Boilers is demonstrated in this view of two 10-million Btu units installed at a new Michigan high school.

COMBUSTION ENGINEERING

Combustion Engineering Building, 200 Madison Avenue, New York 16, N. Y.

C-190

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT: NUCLEAR REACTORS; PAPER MILL EQUIPMENT; PULVERIZERS, FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE

The list at right points up the versatility and widespread acceptance of Combustion Engineering's HCC boiler. For industrials, schools, institutional use, military bases—wherever there is extensive space to be heated—C-E high temperature water has a place.

Featuring the same principle applied by Combustion in many of its large utility boilers, the C-E LaMont Controlled Circulation Hot Water Boiler offers a compact and effective arrangement of heating surfaces. This design gives precision temperature control, and, dependent upon local conditions, the HCC can save 10 to 20 per cent in maintenance and operating costs—a significant factor when considering a heat source.

Available in a wide capacity range—from 10 to 300-million Btu's—these boilers operate at water pressures up to 500 psi and temperatures to 470 F or higher. The smaller capacity HCC's are completely shop-assembled, while the intermediate and large units are shipped in varying stages of assembly. This C-E practice greatly reduces erection costs.

If you are in the market for boilers, either for space heating or process requirements, it may prove greatly to your advantage to investigate C-E high temperature water as your heat source.

Because individual needs vary, *both* steam and hot water have their applications. Combustion Engineering can furnish either, and our engineers are exceptionally qualified to discuss *impartially* with you or your consultants the method most suitable for your situation.

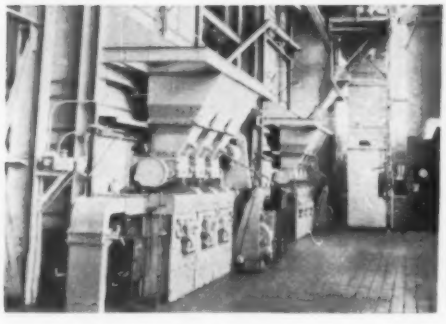
Write for further details on Combustion Engineering's High Temperature Water Boilers.

Representative list of C-E HCC Boilers in service, under construction, or on order

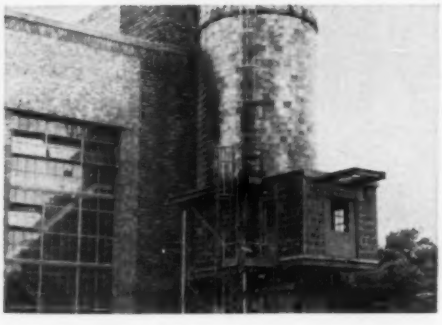
	No. of Units	Normal Output ea.—Btu/Hr. (millions)	How Fired
A. E. Smith High School Riverview, Michigan	2	10	Oil
J. Bishop & Co. Malvern, Pa.	1	12	Oil
Colorado State College Greeley, Colo.	1	60	Oil— Nat. Gas
Cress Company, The Frazer, Michigan	2	12	Nat. Gas— Oil—
Defense Construction Ltd. Camp Gagetown, N. B., Canada	3	70	Pulv.Coal— Gas
Erie Mining Company Aurora, Minn.	2	85	Stokers— Oil or Gas
Convair Astronautics Div. General Dynamics Corp. San Diego, Calif.	2	30	Oil— Nat. Gas
General Motors Overseas Santos, Brazil	1	12	Oil
Hillcrest Medical Center Tulsa, Oklahoma	1	30	Nat. Gas
Marquardt Aircraft Co. Ogden, Utah	2	12	Oil— Nat. Gas
Michigan State University Oakland, Michigan	1	12	Oil— Nat. Gas
New Florida State Prison Raiford, Florida	2	30	Oil— Nat. Gas
North Carolina Wesleyan College Rocky Mount, N. C.	2	10	Oil— Nat. Gas
U. S. Air Force Academy Colorado Springs, Colorado	3 2	100 30	Oil— Nat. Gas
U. S. AIR FORCE:			
Dayton Air Force Base Dayton, Ohio	1	30	Stoker
Dover Air Force Base Dover, Delaware	3	50	Oil— (Fut. Coal)
Forbes Air Force Base Topeka, Kansas	3	42	Oil— Nat. Gas (Fut. Coal)
Grand Forks Air Force Base Grand Forks, North Dakota	2	25	Stokers— Oil
Minot Air Force Base Minot, North Dakota	2	25	Stokers— Oil
Plattsburgh Air Force Base Plattsburgh, N. Y.	2	50	Oil
Portsmouth Air Force Base Portsmouth, N. H.	2	110	Oil— Nat. Gas (Fut. Coal)
Wilmington Air Force Base Wilmington, Ohio	1	16	Stoker
Wrightstown Air Force Base Wrightstown, N. J.	4	50	Stokers
Wuthsmith Air Force Base Oscoda, Michigan	2	25	Stokers
Air Force Base Torrejon, Spain	3	43	Oil
U. S. Navy Auxiliary Air Station Fallon, Nevada	2	15	Oil

One of the many large plants using C-E High Temperature Water Boilers is Convair-Astronautics Division of the General Dynamics Corporation. Installed at this new $40-million center for Atlas Intercontinental Ballistic Missile research, development, manufacture, and primary testing are two 30-million Btu HCC Boilers.

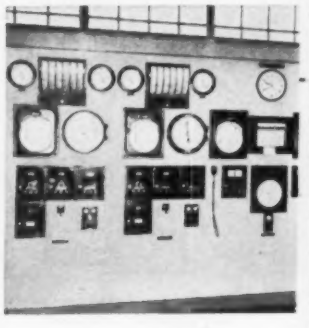
For more data circle 513 on Post Card



Firing aisle shows both Union Iron Works boilers . . . identical 2-drum, bent-tube type with a normal rating of 70,000 lb/hr. These units are fired by Detroit Rotograte Spreader Stokers.



Furnace ash and dust from Prat-Daniel Collectors are conveyed pneumatically to this 50-ton ash storage silo. Rotary dustless unloader assures a clean operation. Ash handling system is by United Conveyor Corp.



Combustion controls and instruments — centered in this control panel by Hays Corporation — regulate combustion and auxiliary operations automatically.

Coal scores with Notre Dame

University power plant burns coal for modern steam generation

Enrollment growth and building expansion had put a strain on the power plant at the University of Notre Dame, South Bend, Ind. After careful study—by the consulting firm of Albert Kahn Associated Architects and Engineers, of Detroit—a decision was made to modernize steam facilities and add power generating equipment. Two new coal-fired boilers, a turbo-generator and auxiliary equipment were installed.

Maximum efficiency is achieved through automatic combustion control and complete instrumentation. Today steam is generated *economically.* Another noteworthy result of these innovations has been the *cleanliness* of operation . . . making Notre Dame's power plant a model of good housekeeping.

Coal is lowest-cost fuel

Today, *when the annual cost of fuel often equals the original cost of the boilers,* you should know that bituminous coal is the lowest-cost fuel in most industrial areas. And modern coal-burning equipment gives you 15% to 50% *more* steam per dollar, while automatic operation trims labor costs and eliminates smoke problems. What's more, tremendous coal reserves and mechanized mining procedures assure you a constantly plentiful supply of coal at stable prices.

Consult an engineering firm

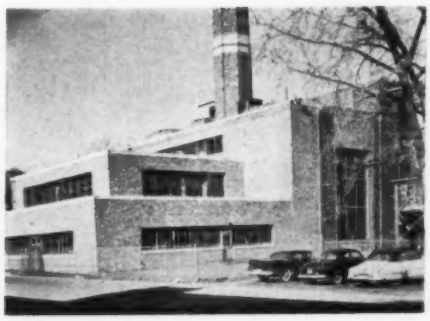
If you are remodeling or building new heating or power facilities, it will pay you to consult a qualified engineering firm. Such concerns—familiar with the latest in fuel costs and equipment—can effect great savings for you with the efficiency and economy of coal.

Technical advisory service

To help you with fuel problems, the Bituminous Coal Institute offers a free technical advisory service. We welcome the opportunity to work with you, your consulting engineers and architects. If you are concerned with steam costs, write to address below or send coupon. Ask also for case histories booklet, complete with data sheets. You'll find them informative.

BITUMINOUS COAL INSTITUTE

Department PE-12, Southern Building, Washington 5, D. C.



Exterior view of Notre Dame power plant. Careful planning of design combines spacious interior and pleasing exterior lines to maintain campus beauty.

SEND COUPON FOR NEW "Guide Specifications for Underfeed Stoker Fired Low-Pressure Heating Plants." Heavy demand for the first edition of this booklet, adaptable for design loads 3,000 to 26,000 EDR steam, has justified an expanded edition covering application of underfeed stokers to firetube, watertube and sectional cast iron boilers. Complete specifications criteria cover all aspects of typical heating plant.

BITUMINOUS COAL INSTITUTE, Southern Bldg., Washington 5, D. C. PE-12

Gentlemen: Please send me:

☐ Guide Specifications Booklet ☐ Case histories on larger plants

☐ I am interested in your advisory service

Name_____

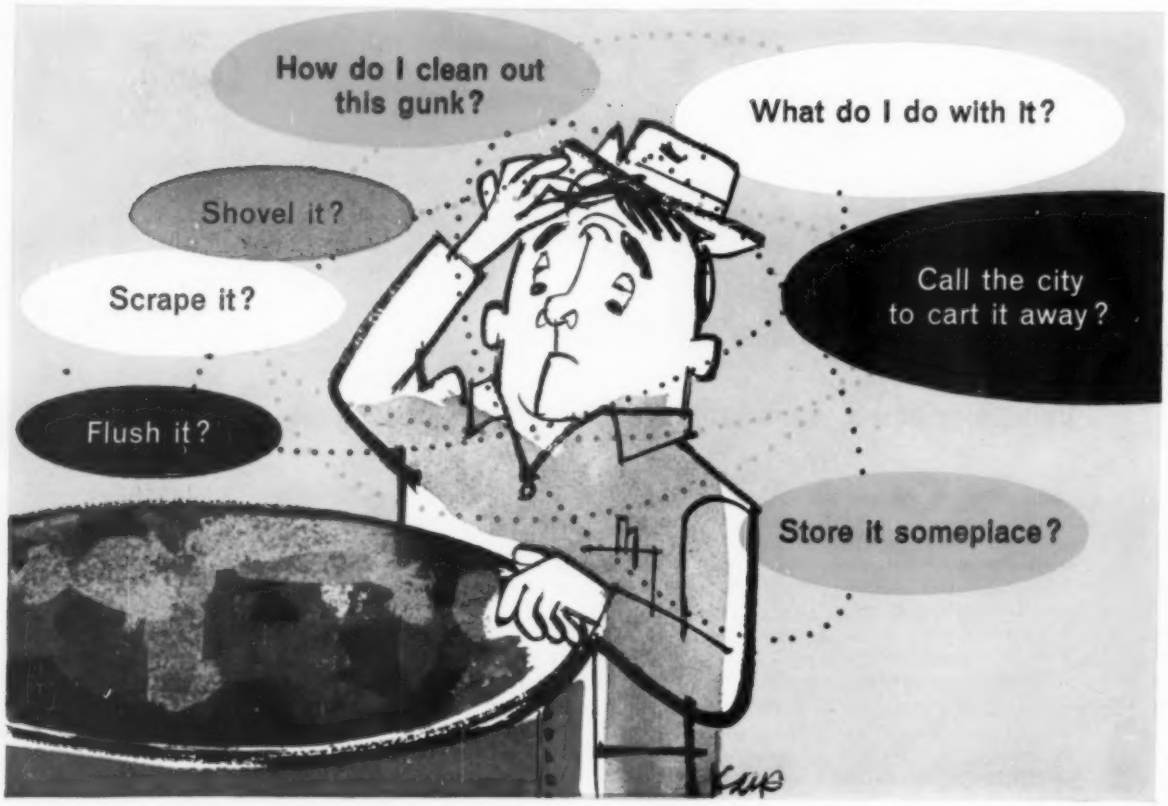
Title_____

Company_____

Address_____

City_____ Zone_____ State_____

For more data circle 514 on Post Card



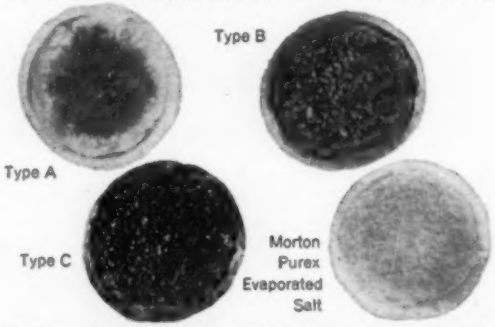
Brine tanks never need cleaning out when you use sludge-free Purex Salt

Yes, we mean never! You prevent costly shutdowns for maintenance. You save time and completely eliminate labor costs for cleaning out brine tanks. For Morton Purex Salt is 100% soluble. It will leave no accumulation of sludge—shale and sulphates—in either your brine or water-softening system.

What's more, none of your purchase price or freight bill for Purex goes toward paying for insolubles. This is an important saving, for in every 100 lbs. of ordinary salt you buy, you assume the risk of paying for up to 5 lbs. of shale and sulphates. In a 50-ton carload of ordinary salt, you may pay for as much as 5,000 lbs. of sludge. And you buy salt with "built-in" maintenance problems.

With sludge-free Morton Purex Salt, you get high-purity evaporated salt made in a controlled-particle size to prevent packing and channeling. Purex can be used in bulk wet storage systems and in the Morton Model E Brinemaker.

These filter pads (approximately 1/6 actual size) show you how much insoluble matter (sludge) you get in just 5 lbs. of various types of salt



Tests for insolubles taken from these random samples show you that Morton Purex is the only one that contains no wasteful sludge or insolubles.

For more information about Morton Purex Salt and for free, expert help on any water-softening or brine-making problem, write or wire:

MORTON SALT COMPANY
INDUSTRIAL DIVISION
Dept. PoE 12-58, 110 N. Wacker Drive
Chicago 6, Illinois

For more data circle 515 on Post Card

HELPFUL BULLETINS

New and revised publications reviewed on these pages offer help on operating and maintenance problems. To order, use the handy Reader Service Cards provided on pages 119 and 120.

WATER CONDITIONING

101 Ion Exchange Explained — Nalco Bulletin Z-5, "Water Conditioning with Nalcite Ion Exchangers," is a 60-pp handbook explaining the ion exchange technique and detailing several types of ion exchange systems and the quality of water supply each can produce. Softening, dealkalizing, and demineralizing processes are discussed from standpoint of equipment and chemicals required. National Aluminate Corp.

102 Demineralizing Handbook — Publication 5800-D is a 36-pp handbook on demineralizing featuring sections on history of water treatment, definition of terms, building the demineralizer system, and describing various types of demineralizer operations. Photos, drawings, flow diagrams, and graphs are included, as well as table showing operating results and costs. Cochrane Corp.

INSTRUMENTS, CONTROLS

103 Process Instruments — Described in 52-pp Catalog 2 is a line of process instruments, including indicators, transmitters, recorders and controllers for flow, pressure, temperature, density, viscosity and consistency. Photos, drawings and diagrams are included, with detailed selection data, capacities and specifications, dimensions, operational limits curves, sizing nomographs, and other information. Fischer & Porter Co.

104 Recorders, Indicators — Bulletin GEA-6792, 12 pp, provides latest descriptive information on new single-point and multi-point strip-chart recorders and recording controllers, round-chart recorder, recording controller and circular scale indicator, precision indicator, and control forms. Describes features: contains application data and specifications, shows outline and mounting dimensions, and includes photos. General Electric Co.

105 For Metering Fluids — Subject of Bulletin 115-LIB is a low cost, precise Dall flow tube designed to reduce pumping costs by delivering lowest head loss. Bulletin contains photos, dimensional and capacity table, installation diagrams, pressure-recovery performance chart. Builders-Providence, Inc.

106 For Pipe Flow Measurement — Bulletin 18B describes Bypass Rotameters for measuring rate of flow in pipelines 2-in. diam and larger. Presents simplified instructions for determining permanent pressure loss across the main orifice and the required straight run of pipe before and after the main orifice. Schutte and Koerting Co.

107 Variable-Area Flowmeter — Specification Bulletin 10A1152 describes a variable-area flowmeter (with a maximum pressure rating of 300 psi) that may be also used for elevated temperature applications for both liquid and gas service. Gives operational limits, materials of construction, performance, capacity tables. Fischer & Porter Co.

108 Valve-Regulator Tips — Installation, operation and maintenance instructions for Rockwell-Nordstrom valve-regulators are described in Bulletin 1099, 16 pp. This valve-regulator is a pneumatically controlled, cylinder operated, lubricated plug valve-regulator designed to provide high-pressure, large-volume gas regulation with minimum pressure loss. Typical installations, mounting and piping arrangements are shown. Also included are line, cutaway and schematic drawings and characteristic curves. Sections are devoted to trouble checking, orifice and nozzle cleaning, operation and positioner and controller. Meter and Valve Div., Rockwell Mfg. Co.

109 Steam Meter — "Accurate Steam Metering for 1-1-½ in. Lines" is the title of 8-pp Bulletin 400-P25. Profusely illustrated with photos, cross sectional views, dimensional drawings, capacity and accuracy tables, bulletin describes features, operation, installation and specifications of the steam meter. Builders-Providence, Div. B-I-F Industries, Inc.

110 Industrial Gages — This 40-pp catalog contains detailed descriptions, specifications and applications for over 250 gage models, including pressure, vacuum, compound, pneumatic and electric transmitter, receiver, and test gages; chemical protectors, and various gage accessories. Basic design features are detailed on exploded view showing typical gage. A listing of available models, is also included, as well as weights, general dimensions, and various tables. International Register Co.

111 Gas Analysis Instrument — The Thermatron, a process control instrument for continuous measurement of the concentration of one gas in multi-component mixtures is described in Bulletin 0716-2. Explains selective measurement through use of two different types of cells having identical filaments. Applications to a variety of gas analysis problems are suggested. Mine Safety Appliances Co.

FANS, BLOWERS

113 Ventura Fans — Bulletin 8914 describes an expanded line of ventura fans for high and low pressures. Tables give fan speed, motor horsepower, quietness rating and net weight as well as delivery over a range of static pressure values. Also included is chart explaining significance of quietness ratings, and installation type drawings and dimensional data. American Blower Div., American-Standard.

114 Mechanical Draft Fans — Eight-pp Catalog 1361 describes centrifugal fans designed for handling abrasive gases at elevated temperatures. Complete application, performance, and physical data are given, as well as a list of optional accessories. Sturtevant Div., Westinghouse Electric Corp.

115 Air Moving Units — Illustrated and described in 16-pp Bulletin 5412 are special purpose air moving units, including packaged centrifugal blowers, vaneaxial fans, tubeaxial fans, propeller fans, pressure blowers, and fluid coolers. Specifications include capacity range, operating speed, construction features and typical industrial applications. American Blower Div., American-Standard.

COMPRESSORS

116 Centrifugal Compressors — Bulletin 165 describes single stage centrifugal compressors for petrochemical and refinery applications. Details are given on casings, bearings, seals, impellers, lubrication system, baseplates and couplings, plus recommended applications. Clark Bros. Co.

117 Low Pressure Compressors — Eight-pp Bulletin A-95 covers heavy-duty, low-pressure compressors. Provides specifications on three models from 756 to 7392 cfm and includes a detailed sectional drawing. There is also a run-down, with illustrations, on parts and features. Joy Mfg. Co.

118 Centrifugal Compressors — Twenty-pp Bulletin 909 describes construction and operating features of company's centrifugal compressors and lists some typical applications. Ratings based on ASME Test Code are presented in tabular form for typical pressure-volume-horsepower selections in the range of pressures and volumes most frequently encountered. Possible arrangements are illustrated and line drawing showing positions in which compressor discharge can be located is included. American Blower Div., American-Standard.

PACKINGS, SEALS

119 Mechanical Seals — Precision mechanical seals for almost every rotating shaft sealing problem are described in this bulletin. Design features are illustrated with cutaway views and advantages are detailed. Borg-Warner Corp.

120 Compression Packings — Featured in this 22-pp bulletin is a line of compression type packings, including both the sheet and rod seal types common to industry. Profusely illustrated, bulletin describes materials, constructions, recommended services, and typical applications. Packing recommendation charts are included. E. F. Houghton & Co.

121 Mechanical Seal — Eight-pp Bulletin AD-164 describes Chemiseal, a corrosion-resistant mechanical seal combining properties of Teflon with features of bellows design. Lists advantages of bellows design, types of seals available, optional designs, specifications and installations. The Garlock Packing Co.

VALVES

122 Control Valves — Twelve-pp Bulletin LB-3 gives details on construction and operating characteristics of company's

Series LB control valve. Various design features are described, operation of valve positioner shown in detail, and advantages of tight shut-off in a control valve explained. Complete specifications and valve sizing data are included. Conoflow Corp.

123 Plastic-Lined Valves — Bulletin 114 describes Penton plastic-lined valves compatible with glass, plastic, metallic and lined piping. Characteristics, advantages, and temperature and pressure specifications are covered, and chemical resistance ratings for a variety of services listed. Hills-McCanna Co.

MECHANICAL POWER TRANSMISSION

125 VP Drives Motor Bases — In addition to providing full selection data for company's variable pitch drives, 12-pp Catalog V-183-B features new welded steel sliding motor bases. These are particularly applicable for wide range variable pitch drives requiring more take-up than many V-drives. Browning Mfg. Co.

126 Dry Fluid Drives — An expanded line of dry fluid drives and couplings is described in 24-pp Bulletin A-640B. Complete with product photos and engineering drawings, installation pictures showing applications in a broad cross-section of industry, explains how this device solves many difficult drive problems. Dodge Mfg. Corp.

127 Adjustable Speed Drives — Bulletin GEA-6234B, 8 pp, describes general-purpose Thymotrol adjustable speed drives, 1 hp half-wave and 1 to 4 hp full wave. Explains standard and optional features, electrical and performance characteristics, application advantages, and construction features. Photos, cutaway drawings, line drawings, and charts are included. General Electric Co.

LUBRICANTS

128 Solid Film Lubricants — Featured in this 16-pp bulletin is a family of solid film lubricants designed to give positive lubrication under conditions of extreme heat, excessive cold, high speeds, and high loads. Specifications are included, as well as curves plotting coefficient of friction, coefficient of friction vs temperature, wear life vs temperature, and tables listing physical properties and characteristics. Electrofilm, Inc.

129 Product Guide — This handy little booklet gives information on manufacturer's line of industrial products — general lubricants, greases, diesel lubricating oils, metalworking oils, hydraulic oils, heat-transfer oils, waxes, petrochemicals, spray oils, solvents, electrical oils and others. Sun Oil Co.

COOLING AND HEAT EXCHANGING

130 Cooling Coils — Fifty-pp Bulletin 880 contains cooling coil selection information as well as detailed descriptive information on the coils, including direct expansion coils, and both standard and cleanable tube water coils. Included in addition to numerous photos are construction specifications, dimensional data, surface charts, circuiting diagrams, capacity rating tables and detailed refrigerant pressure drop charts, and other features. American Air Filter Co., Inc.

131 Ebullient Cooling — Complete information on Dowtherm 209 for use in cooling by means of a boiling heat-transfer medium is contained in this 20-pp bulletin. Discusses advantages of ebullient cooling, such as uniform engine temperature, faster engine warm-up, automatic circulation and temperature control of coolant, elimination of water pump, reduction of corrosion, increased lubricant life and others. The Dow Chemical Co.

132 Heat Exchangers — Comprehensive information on heat exchangers and pressure vessels for the process and power industries is presented in 16-pp Bulletin M581. Contains photos and diagrams which illustrate basic types of heat exchangers and pressure vessels, and other special process and power equipment such as feed water heaters, surface condensers, and steam jet ejectors. Southwestern Engineering Co.

133 Stainless Exchangers — Bulletin 301.6K1 features stainless steel exchangers for production and pilot plant applications of the chemical and process industries. Included are details on important features designed to assure maximum heat transfer, plus specifications. Ross Heat Exchanger Div., American-Standard.

WELDING, HARD FACING

135 Welding Supplies — Catalog 9-13 contains 52 pp of information on welding supplies and accessories. Illustrated with photos, drawings and diagrams, booklet covers fluxes and ferrous and nonferrous rods for gas welding, and accessory items including protective clothing, goggles, electrode holders, sparklighters, cable, hose, weld cleaning tools, cylinder trucks and other items for both arc and gas welding. Air Reduction Sales Co., Div. Air Reduction Co., Inc.

136 Sprayed Metal Coatings — Bulletin 136A is an 8-pp basic engineering data bulletin on wire and powder sprayed coatings of metal and ceramics. Covers basic characteristics of sprayed metal and ceramic coatings, including hardness, tensile and bond strength of various coatings, plus a wide range of mechanical and electrical-electronic applications. Metallizing Engineering Co., Inc.

ELECTRICAL

137 Synchronous Motors — Booklet B-7292, 27 pp, contains motor selector charts, application data, and formulas for calculating power factor for synchronous motors and controls. Presents a quick summary of types and features of motors and controls, and includes a discussion of power factor correction, factors to consider in selecting motor, and special application problems. Westinghouse Electric Corp.

138 Weather-Protected Motor — Six-pp Bulletin 2550 features company's horizontal weather protected motors for outdoor operation under extreme weather conditions, for use in such industries as chemical, petroleum, paper processing, public utility, and for applications in pipeline, boiler feed pump and other outdoor installations. Cutaway drawings showing features are included, as well as specifications. The Louis Allis Co.

139 Lighter Transformers — Bulletin GEA-6790, 8 pp, describes lighter weight, aluminum wound sealed dry-type transformers rated 300 kva and above. As much as 2000 lb lighter than many sealed dry units, these transformers can be installed on balconies, catwalks, or other overhead platforms. Bulletin covers key standard and optional features, design variations, photos, charts, graphs and block diagrams. General Electric Co.

140 Distribution Center — Condensed information on company's expanded line of Tranfo Units — pre-engineered packaged load distribution centers — is supplied in Bulletin 12004-A. In addition to summing up ranges and equipment available in the line, bulletin also discusses advantages of this type of unit in terms of safety, service, flexibility, efficiency and increased ease of installation. I-T-E Circuit Breaker Co.

141 Distribution Transformers — Bulletin S-401-C gives data on two lines of distribution transformers — the conventional and the super-standard single phase oil filled units. Presents a formula for calculating annual operating costs of distribution transformers. The Standard Transformer Co.

142 Control Center — Bulletin 2-2000A outlines features and specifications of company's control centers. Covers two major components of the centers — structural sections and electrical control units. General features, construction, parts, and dimensions are described for each, and specifications included. Federal Pacific Electric Co.

143 Control Centers — Bulletin PAN-10-58 describes Pushmatic Electri-Centers with pushbutton convenience. Circuit diagrams and box size and knockout diagrams are included in the bulletin. Bulldog Electric Products Co., Div. I-T-E Circuit Breaker Co.

144 Small Panel Instruments — Bulletin GEA-6678, 6 pp, describes in text, pictures and tables company's "big look" in small panel instruments, d-c and a-c. Cutaway views show features such as self-shielding, and complete information is given on ratings, dimensions, pricing, size and panel drilling plans and other details. General Electric Co.

145 Voltage Regulators — Bulletin GED-3468A is a pocket-size, 16-pp booklet giving examples of voltage regulation problems and applications on long and short feeders. Outlines methods of using step regulators at reduced ranges of regulation with increased current capacity. General Electric Co.

Postage-free cards for ordering catalogs are on page 119. You may also use the cards to order literature mentioned in the ads.

146 Stationary Batteries — Design improvements in company's line of stationary batteries are reviewed in 8-pp Bulletin 6205. Text, photos and cutaway views show how design improvements contribute to greater power and extended battery life, lower internal stresses, less frequent addition of water, and elimination of possibility of sediment shorts in cells. Exide Industrial Div., The Electric Storage Battery Co.

147 Battery Connectors — Described in 20-pp Catalog GB-7-2958 are battery connectors for engine starting, simplifying battery change, and general

Built with stainless-clad steel

NEW BUNKER NOSES STAY NEW

This sample was cut from a plate of Lukens stainless-clad steel that had handled coal for 9½ years in a leading eastern utility. It not only stayed new but sliding coal actually polished its surface, kept it smooth. Costly hang-ups were cut to a minimum.

Lukens clad steel is not a lining but a solid plate—one side corrosion resistant stainless steel permanently bonded over all to a rugged backing steel. Not only in bunker noses, but in hoppers, chutes and spreaders, too, clad steel assures ready fabrication, easy modification, reduced maintenance and freedom from down time.

Bulletin 740 will give you performance facts and production information. Send in the coupon, and, if you wish, write for the names of experienced coal handling equipment builders. Lukens Steel Company, Coatesville, Pennsylvania.

LUKENS ®

Helping industry choose steels that fit the job

SEND FOR THIS BOOKLET TODAY!

Manager, Marketing Service
LUKENS STEEL COMPANY
137 Lukens Building, Coatesville, Pa.

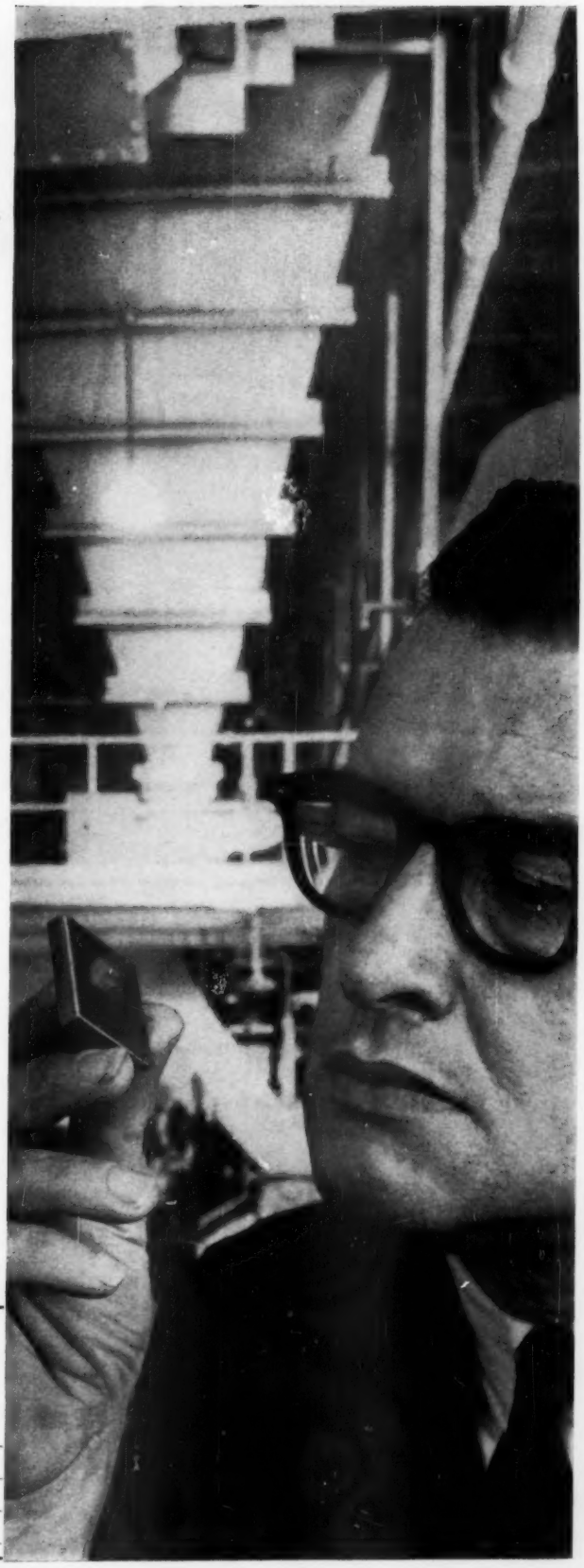
Please send me a free copy of your 16-page booklet, "Stainless-Clad Steel for Coal Handling."

NAME _____ TITLE _____

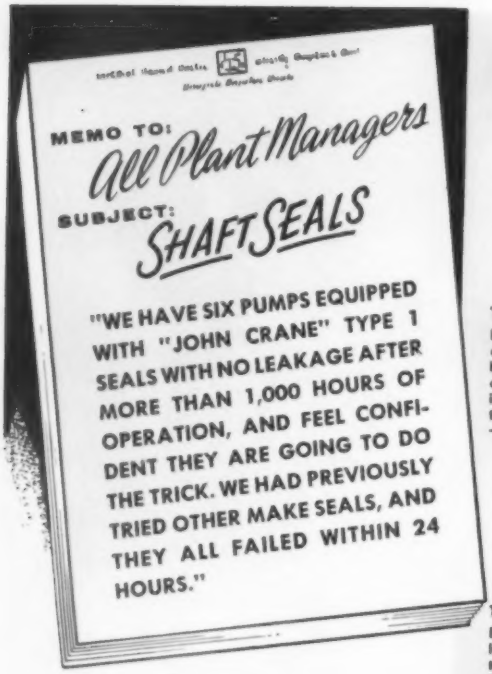
COMPANY _____

STREET ADDRESS _____

CITY _____ ZONE _____ STATE _____



For more data circle 516 on Post Card


MEMO TO:
All Plant Managers
SUBJECT:
SHAFT SEALS
"WE HAVE SIX PUMPS EQUIPPED WITH "JOHN CRANE" TYPE 1 SEALS WITH NO LEAKAGE AFTER MORE THAN 1,000 HOURS OF OPERATION, AND FEEL CONFIDENT THEY ARE GOING TO DO THE TRICK. WE HAD PREVIOUSLY TRIED OTHER MAKE SEALS, AND THEY ALL FAILED WITHIN 24 HOURS."

This is part of an actual memo sent by one plant manager to others of the same company in different sections of the country—and that company is now exclusively specifying these and other type "John Crane" Shaft Seals for *all* their liquid handling requirements.

You too can save time, trouble and expense by doing likewise.

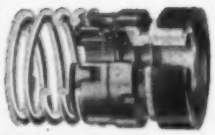
You'll find a "John Crane" Shaft Seal for every service . . . from hot or cold water to the most destructive acids and corrosives . . . high temperatures, high pressures . . . in types and sizes to meet practically any mechanical or dimensional requirement.

Send us details on your application. We'll recommend the proper shaft seal. Request Bulletin S-204-3 for complete overall information.

Crane Packing Co., 6429 Oakton St., Morton Grove, Illinois, (Chicago Suburb).

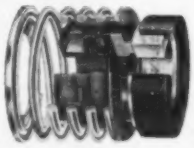
In Canada: Crane Packing Company, Ltd., Hamilton, Ont.

John Crane



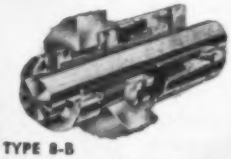
TYPE 1

Designed for limited stuffing box diameter. Handles water, light hydrocarbons, refrigerants, mild acids and other liquids non-injurious to synthetic rubber at temperatures from −40°F. to +212°F., pressures to 200 psi.



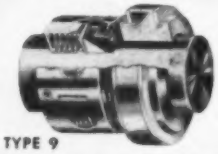
TYPE 2

Designed for limited stuffing box length. Handles same services, temperatures and pressures as Type 1.



TYPE 8-B

Heavy duty, high pressures. Packaged construction for easy installation. Handles pressures to 1200 psi., temperatures from −40°F. to +250°F. Services same as Type 1.



TYPE 9

Famous as a problem solver. Sealing members of chemically inert Du Pont Teflon. Engineered to service conditions to handle practically all destructive acids, corrosives and gases at temperatures from −120°F. to +500°F., pressures to 150 psi. Available in balanced construction for pressures to 750 psi.

For more data circle 517 on Post Card

power use. Covers the complete line of plugs designed specifically for high current-capacity and battery disconnect applications. Cannon Electric Co.

148 Stationary Batteries — Bulletin CP-541 covers use and design of company's line of low capacity light duty lead-antimony grid batteries for control, switchgear, auxiliary power and other stationary applications. Includes complete data on the two- and three-cell sizes with 50- and 100-amp-hr ratings, curves on discharge characteristics, rack data and accessory details. C & D Batteries, Inc.

149 Conductor Slide Rule — This handy logarithmic conductor slide rule is designed to aid in selecting dimensions of aluminum foil or sheet for use in strip-wound electrical coils. It provides a means of converting from standard wire sizes in copper or aluminum to an equivalent aluminum strip conductor. Wire size is set on a reference scale, and a wide range of equivalent strip conductor size combinations of width and thickness is shown on a selector scale. Other information provided includes cross-sectional area of wire, and weight and electrical resistance of equivalent strip and wire. Aluminum Co. of America.

150 Rigid Steel Conduit — Advantages of rigid steel conduit in electrical distribution systems are outlined in illustrated 12-pp Bulletin RCP-940. Installation features are also shown. Charts give complete information on dimensions and weights, packaging, cable capacity of conduit. Rome Cable Corp.

151 Electrical Metallic Tubing — Product uses, features and manufacturing processes of electric metallic tubing are detailed in 12-pp Bulletin RCP-900. Recommended applications are outlined, and charts are included which detail number of cables that each conduit size will accommodate. Installation information, sizing chart, and suggested specification included. Rome Cable Corp.

152 Conduit Pipe Fittings — Detailed in 8-pp Catalog 204 is a line of aluminum conduit standard radius elbows, aluminum conduit extra large radius elbows, aluminum conduit pipe couplings and aluminum conduit pipe nipples. Weights and dimensions and other data are tabulated. Conduit Nipple Mfg. Co.

153 Cable Supports — Various types of supports to hold cables, instrument piping and multitube are featured in 80-pp Catalog 858. Photos, drawings, diagrams, schematic drawings, specifications, and deflection data are included in the bulletin. P-W Industries, Inc.

154 Electrical Enclosures — This catalog describes a line of dust and oil-tight electrical enclosures made of sheet steel, including wiring boxes, control panel enclosures, control consoles, pushbutton enclosures, wireway, and wiring troughs. Features and applications are detailed and specifications and dimensional diagrams included. Hoffman Engineering Corp.

INSULATION, ACCESSORIES

155 Insulation Adhesives — Bulletin I-C 58 contains a wealth of information on Insul-Coustic insulation adhesives, weatherproofing, coatings, vapor barriers, and sealing compounds. Included are facts on applications, properties, temperature ranges, coverage per gallon, and suggestion

The City of Memphis Saves Installation Time and Money . . . . . with BALDWIN-HILL MONO-BLOCK®

In the Thos. H. Allen Electric Generating Station of the Memphis Light, Gas and Water Div., the recirculating gas headers and ducts of three steam generators were quickly insulated with B-H Mono-Block.

The photos, of the gas header at the top and duct below, show two layers of Mono-Block being applied over road mesh and tied with 14 gauge galvanized wire. Contributing to the speed of application is the ease with which holes for threading the wire are cut in the Mono-Block. Nothing but a sharp knife is needed. With the blocks secured in place, the holes were filled and joints pointed with B-H No. 1 Insulating Cement.

When completed, each of the station's three units will have a capacity of 2,100,000 lbs per hr to make it the 10th largest steam plant in the country.

Insulation Contractor:
M. H. Ellis Company,
Memphis, Tenn.

BALDWIN-HILL Company

CONTRACT APPLICATION SERVICE AVAILABLE

212 Breunig Ave., Trenton 2, N. J.

Kalamazoo, Mich. . . . Huntington, Ind. . . . Temple, Tex.

For more information on B-H Mono-Block, B-H No. 1 Insulating Cement and other B-H Insulations, write for catalog or see it in Sweet's Plant Engineering File.

For more data circle 518 on Post Card

ROTOJET®
Tube Cleaners

Clean tubes and pipes from ½" to 12" I.D. THOROUGHLY QUICKLY

ROTOJET Model 512 Air-driven Motor, universal joint, swing-frame head, and solid brush.

Our large stock of Rotojet air-driven and water-driven tube cleaners, accessories, and repair parts for straight and curved tubes, pipes, and transfer lines is available to meet most requirements without delay. Tube cleaner specialization for 43 years assures satisfactory results from any Rotojet equipment we recommend. Send for Bulletins J-410 and R-105. For quick action wire or phone, HUmboldt 3-0570.

ROTOJET Model C-525 Air-driven Motor with swing-frame head and universal joint.

ROTOJET Model C-526 Air-driven Motor with pivot head and universal joint.

ROTOJET Junior Model S32 Air-driven Motor, universal joint, cone cutter.

ROTOJET Junior Model C434 Air-driven Motor, flexible coupling, expanding brush.

ELLIOTT COMPANY – ROTO PLANT
Tube Cleaner Specialists Since 1910

147 Sussex Avenue, Newark, N. J.

For more data circle 519 on Post Card

on how to save money by using the material. Insul-Coustic Corp.

156 Block Insulation — This 8-pp brochure contains detailed information on advantages of Abosite — a durable, lightweight, block type insulating material composed of asbestos fibers bonded with an inorganic silicate binder. Recommended specifications for vessel insulation are included. The Aber Co., Inc.

157 Insulation for Cold Spots — Twelve-pp Booklet FL-104 covers use of Foamglas insulation in low temperature apces. Contains photos and brief descriptions of new and unusual types of cold storage enclosures made possible by the physical characteristics of this cellular glass insulation. Pittsburgh Corning Corp.

HEATERS AND HEATING

158 Gas-Fired Heaters — Advantages of company's gas-fired unit heaters are detailed in 8-pp Catalog gf-58. Among the subjects covered are unit location, mounting heights, length of throw, performance specifications, weights and dimensions. Grinnell Corp.

159 Water Heaters — Bulletin J-1, 8-pp, includes concise data on instantaneous heater, booster and converter units. Includes descriptions, model numbers, capacities, pressures, ratings, dimensions, weights, and list prices. The Sims Co. Inc.

160 Heating Coils — Bulletin 890, 30 pp, contains coil selection information as well as descriptive information on the coils themselves. Included, are construction specifications, dimensional data, surface charts, circuiting and piping diagrams, etc. Temperature rise charts are given in the steam coil section of the bulletin, as well as face velocity charts, altitude and temperature correction charts, steam-pressure-and-temperature correction-factor chart, and condensate tables are included. American Air Filter Co., Inc.

OTHER EQUIPMENT

161 Manifold System — Production, space and cost benefits in continuous distribution of industrial gases by custom-built manifold installations are described in this 28-pp bulletin. Duplex, simplex and portable manifold distribution systems piping oxygen, hydrogen, nitrogen, helium, argon, acetylene and other gases for welding, cutting, heating, flame hardening, flame blasting and oxygen lance operations are detailed. National Cylinder Gas, Div., Chemetron Corp.

You'll save time in ordering bulletins by using the Reader Service Cards on page 119. Of course we honor letterhead requests—but it takes us somewhat longer to handle them.

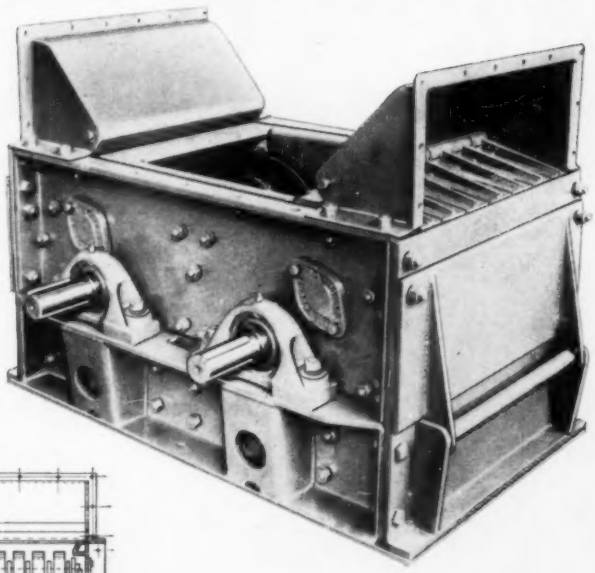
162 Boiler Return Systems — Catalog 55-C, 20 pp, is a revised and expanded presentation of manufacturer's line of boiler feeding systems, deaerating systems, boiler feed pumps and power plant accessories. Recent design developments are covered in detail, including DuraHard Electrolized impellers. A selection guide is provided to aid in determining best system

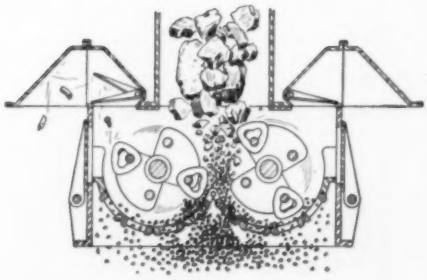
Reduce Coal to size in One Operation!

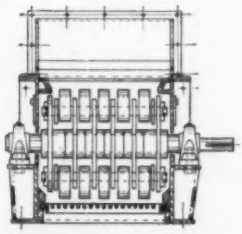
S-A RING TYPE KNITTEL CRUSHERS

HANDLE MAXIMUM SIZE LUMPS OF 14" TO 30"

CRUSH DAMP COAL IN SUSPENSION WITHOUT PLUGGING OR DECREASE IN CAPACITY!







S-A Knittel crusher is provided with tramp iron release fingers. Service and inspection doors are located at either end. Rotor shafts turn on Sealmaster Ball Bearings.

STEPHENS-ADAMSON

THE BIG NAME IN BULK MATERIAL HANDLING EQUIPMENT

MFG. CO.

MAIN OFFICE AND PLANT
86 RIDGEWAY AVENUE
AURORA • ILLINOIS

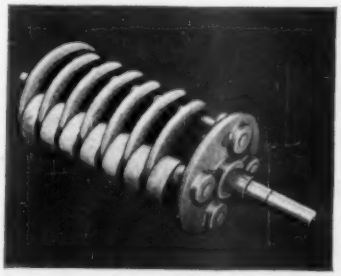
PLANTS LOCATED IN: LOS ANGELES, CALIF. CLARKSDALE, MISS. • BELLEVILLE, ONTARIO

STEPHENS-ADAMSON crushers are built in several styles. A highly successful type, used in the sizing of coal, is the double rotor unit which splits lumps while they are in suspension, eliminating need of breaker plates. Full capacity is maintained. There is no clogging and even wet coal is reduced in a single, swift operation.

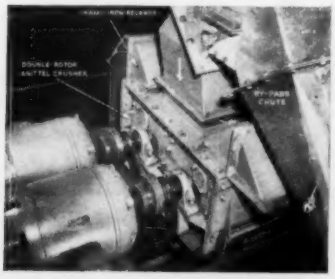
By using two rotors of smaller diameter, the double Knittel crusher will handle the same size lumps as larger single roll crushers which require greater headroom. Furthermore, no increase of power is required. Revolving rotor parts are free to recoil under impact with foreign material, thus preventing rotor injury.

A pioneer designer and manufacturer of conveying equipment for over half a century, STEPHENS-ADAMSON has created many of the world's finest coal handling systems. Whether you need a single conveyor product, or a fully engineered system, there's a member of the S-A sales engineer team in your area. He is eminently qualified to advise you. For complete catalog data on Knittel crushers, write for our bulletin 12-C.

S-A district or main plant offices can supply complete information on any conveyor product or any phase of coal handling. Just write or call.



Shown here is one of the two rotors from a double rotor Knittel crusher. The triangular sectors in each rotor assembly rotate toward each other at speeds up to 1150 R.P.M. Up to 1275 T.P.H. of bituminous coal can be handled in standard Knittel crusher sizes.



This double rotor type Knittel crusher installation sizes coal for an industrial power plant. Lumps are split and fragments are fed thru sizing grates beneath the twin rotors. Coal is then carried away by belt conveyor to outside storage or to boiler house bunkers.

For more data circle 520 on Post Card

Safe, sure check on boiler water levels with wide-vision EYE-HYE

The remote gage with liquid indication

EYE-HYE for pressures up to 600 psi

EYE-HYE for pressures up to 3000 psi

Put your boiler water level supervision on a plane with other power plant control facilities — read levels at your control station with Reliance EYE-HYE.

The dependable accuracy of this popular remote reading indicator eliminates "boiler-climbing"; its bright green liquid-column image stands out — mistake-proof. And EYE-HYE's improved design provides visibility over a wide arc — lower pressure models up to 90°; new higher pressure models, to 180°.

Simple manometric design, with no mechanical parts and no adjustments on location. Available with economical special attachment to actuate supplementary alarms . . . Write for catalog information on EYE-HYE for *your* boiler pressure.

The UNITEMP, complete temperature equalizing unit furnished with each EYE-HYE

1884 75th YEAR 1959

The Reliance Gauge Column Company

5902 Carnegie Ave. • Cleveland 3, Ohio

For more data circle 521 on Post Card

for a particular plant application. Fred H. Schaub Engineering Co.

163 Wire Markers — Self-adhesive wire markers are described and pictured in 8-pp Bulletin 130-E. Gives where-to-use information on wire markers made of vinyl-cloth, aluminum foil, all-vinyl, polyester film, oilproof epoxy resin, acetate cloth, glass cloth and other materials. W. H. Brady Co.

164 Thermal Snow Removal — The use of Dowtherm SR-1 in thermal snow and ice removal systems is described in this 20-pp bulletin. Covers properties and advantages of the heat transfer medium, and describes a variety of applications other than snow melting and ice removal. The Dow Chemical Co.

165 High Velocity Equipment — High velocity valve attenuators are described in 24-pp Bulletin K33-A. Technical and factual information on sound control, duct design methods, and proper selection of units is given, and comprehensive graphs, diagrams, and charts are provided. Separate scale drawings and photos of each of five models, showing contiguous construction, included. Connor Engineering Corp.

166 On Chemical Processing — Six-pp bulletin WC-120, details company's equipment and services available in the field of chemical processing. Among processes described are ion exchange, sedimentation, filtration and flotation. Equipment for each is illustrated. A highlight of bulletin is a section on the meaning of recent methods in processing to industry. Graver Water Conditioning Co.

167 For Cold Cargo — This 20-pp booklet, Bulletin 168, describes infra-red heating equipment for thawing frozen coal and other bulk material in railroad cars. Presents a technical description of infra-red heat rays and explains how they can be harnessed to speed up the unloading of materials in freezing weather. Hewitt-Robins, Inc.

168 Belt Conveyor and Idler — Bulletin 458 gives information on a cradle idler and belt conveyor. A description, photos, dimensional drawings and capacity tables of cradle idler, idler H-frames and belt conveyor are included. Information is given on use of the belt conveyor for underground material handling. McNally Pittsburg Mfg. Corp.

169 High Pressure Closures — Bulletin 201.1K1 presents redesigned high pressure closures for company's feedwater heaters and other high pressure, high temperature exchangers. Drawings show their simple, conservative design. Uniform load distribution, elimination of excessive temperature stresses, and other features are described. Ross Heat Exchanger Div., American-Standard.

170 Air-Lighting Systems — Eight-pp Bulletin AD 6765 describes the new Multi-Vent Trofferlite which provides lighting and air conditioning in the same fixture and is applicable to almost any type of building with any type of drop ceiling . . . the air diffuser (a product of The Pyle National Co.) is built into and concealed within the fixture. Bulletin pictures suggested application procedure and presents data on louvered, baffled and open units. Benjamin Electric Mfg. Co.

Giant refineries like Esso Baton Rouge use Sola-Flex® Expansion Joints

FORTY OF AMERICA'S FIFTY largest businesses—power, petro-chemical, nuclear and others – use Sola-Flex expansion joints to help solve difficult piping problems. The giant Esso refinery at Baton Rouge has installed 6 ft rectangular Sola-Flex joints in some of its critical equipment where it is necessary to handle difficult extremes of thermal growth and vibration.

Solar manufactures the most comprehensive line of expansion joints in the world. They are made in a wide variety of stainless and high-temperature alloys in a complete range of sizes, from ½ in. to 35 ft in diameter. Temperatures range from –320F to 1200F; pressures from complete vacuum to 600 psi and up. *And rugged, economical Sola-Flex joints can be "in service" one to four weeks after receipt of order!*

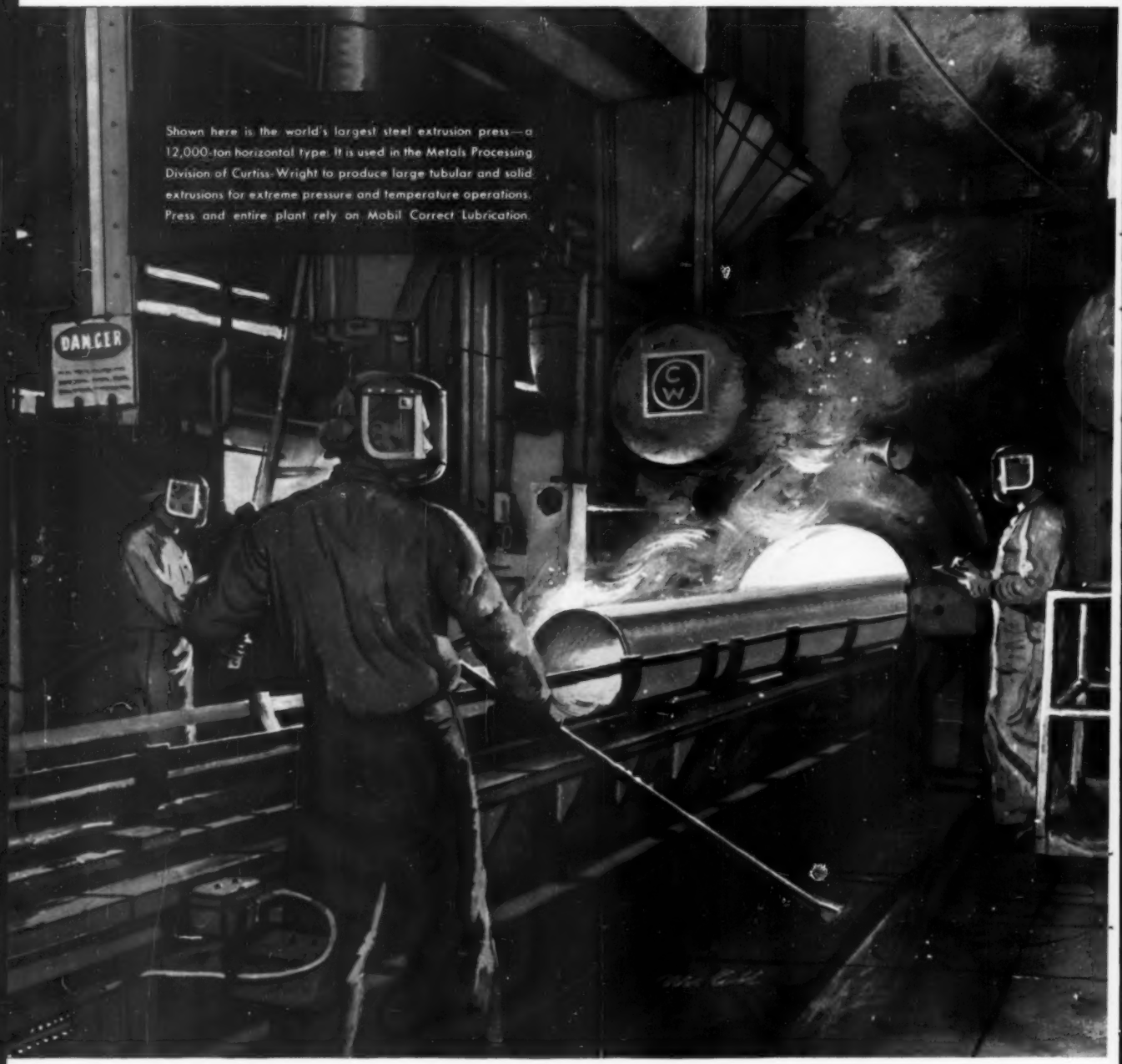
A new pamphlet describes Solar's complete line of Sola-Flex expansion joints. Write for it to Dept. F-94, Solar Aircraft Company, San Diego 12, Calif.

SOLAR AIRCRAFT COMPANY — SAN DIEGO DES MOINES

For more data circle 522 on Post Card

Correct Lubrication in Action...

How Mobil saved



Shown here is the world's largest steel extrusion press—a 12,000-ton horizontal type. It is used in the Metals Processing Division of Curtiss-Wright to produce large tubular and solid extrusions for extreme pressure and temperature operations. Press and entire plant rely on Mobil Correct Lubrication.

Mobil

Complete Engineering Program
Proved Petroleum Products

Mobil

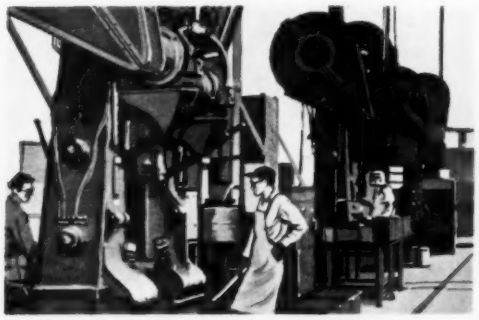
SOCONY MOBIL OIL CO., INC., and Affiliates: MAGNOLIA PETROLEUM CO., GENERAL PETROLEUM CORP., MOBIL OVERSEAS OIL CO., INC.

Curtiss-Wright $8,589

Every time Curtiss-Wright's Metal Processing Division receives a lubricant shipment a big savings is made. Why? Because a Mobil man suggested a new purchasing pattern which brought substantial discounts. Another recommendation saved $1,152 in the company's forging shop.

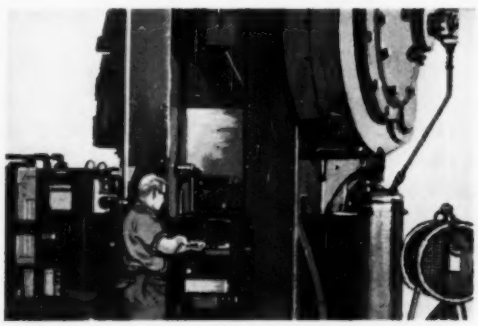
Here are but two instances of Mobil's imaginative engineering service—an important part of *Correct Lubrication.* Alert, qualified engineers in this plant—*but not on the payroll*—have helped save over $8,589.78 in the last year alone. They have worked closely with Curtiss-Wright engineers, setting up maintenance systems, recommending products and methods that have cut downtime . . . improved production in numerous ways.

If you purchase lubricants . . . if you're interested in improving company profits . . . it will pay you to investigate Mobil *Correct Lubrication.* This comprehensive lubrication program often more than pays for itself—in profits!

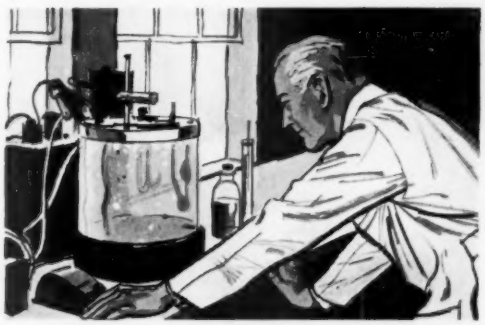


Bearings on drop hammers in Curtiss-Wright's forging shop failed after ten months. Mobil recommended a grease that extended bearing life five years . . . saved $1,152 every ten months.

Curtiss-Wright saves by re-using hydraulic oil as coolant for polishing machine. This saving is part of oil reclamation program organized by Mobil and plant lubrication supervisor. Altogether savings total $5,392 annually.



Bull gears on giant presses required application of grease every week. Mobil recommended improved product that extended application period to monthly intervals . . . cut grease consumption 76% . . . cut application cost $665 per year.



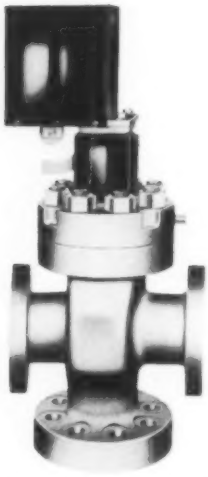
Cooling and lubricating emulsion on cut-off saw broke down into curdly mass. Mobil laboratory analysis pinpointed contamination source. Adding an inexpensive chemical eliminated shutdown and cleaning operation.

Correct Lubrication

Another reason <u>You're Miles Ahead with Mobil!</u>

PRESSURE LOADED SEATING

minimizes leakage and maintenance



Consolidated Electromatic Relief Valve. Sizes: 2½" to 14". Pressures to 3000 psi. Temperatures to 1120°F. Double Outlet.

Consolidated Electromatic® Relief Valves save steam, pure water, fuel, and "wear and tear" on your spring-loaded valves. Pressure loaded seating permits closer adjustment between operating pressure and set point than in spring-loaded valves. Many Electromatics are used to purge superheaters for faster startups and as superheater vent valves. They greatly reduce chances of superheater damage when firing up a cold steam generator or banked boiler.

Pressure loaded seating is created by channeling steam from the pressure vessel around the Electromatic's exhaust and into its main and pilot valve chambers. Steam pressure in both chambers always matches that in the vessel when the Electromatic is closed.

When pressure exceeds the Electromatic's set point, a signal from controller to panelboard control station results in solenoid thrust that opens the pilot valve, venting the steam faster than it can enter the pilot valve chamber through the clearance between the main valve disc and guide. With pressure in the chambers unbalanced, the main valve opens; steam exhausts until boiler pressure is reduced to the pre-determined setting of the controller. The pilot valve and the main valve close instantly at this point. Action is so fast, the closely adjusted Consolidated Electromatic normally relieves overpressure before the spring-loaded valve's set point is reached. For automatic or manual operation or to cut the valve out of service, a switch is provided on the control station. Send for Bulletin 720.

MAXWELL MM&M MANNING & MOORE, INC. TRADE MARK

CONSOLIDATED SAFETY VALVES

A product of

MANNING, MAXWELL & MOORE, INC.

Consolidated Ashcroft Hancock Division • Stratford, Connecticut
In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario

For more data circle 524 on Post Card

modern greases are not always compatible...

...that's why it's important to assure

complete flush *with* Lubriflush*

**exclusive feature of*

U.S. MOTORS

Today's greases have different chemical bases—lithium, sodium, calcium, barium, and other bases which your people can't be expected to keep track of. Some of these greases will not mix safely with others. Because certain chemical bases may react with each other, mixed grease may change its characteristics and become unsuitable for bearing lubrication. That is why U.S. LUBRIFLUSH—an exclusive feature of U.S. Motors—is so important. With this transverse lubrication system, old grease is *completely* flushed out as new grease is forced in. There's no mixing. New grease can be put in without bothering to determine whether it's basically compatible with the old. LUBRIFLUSH, moreover, assures proper lubrication for longest bearing life. Another good reason to specify: "U.S. ELECTRICAL MOTORS."

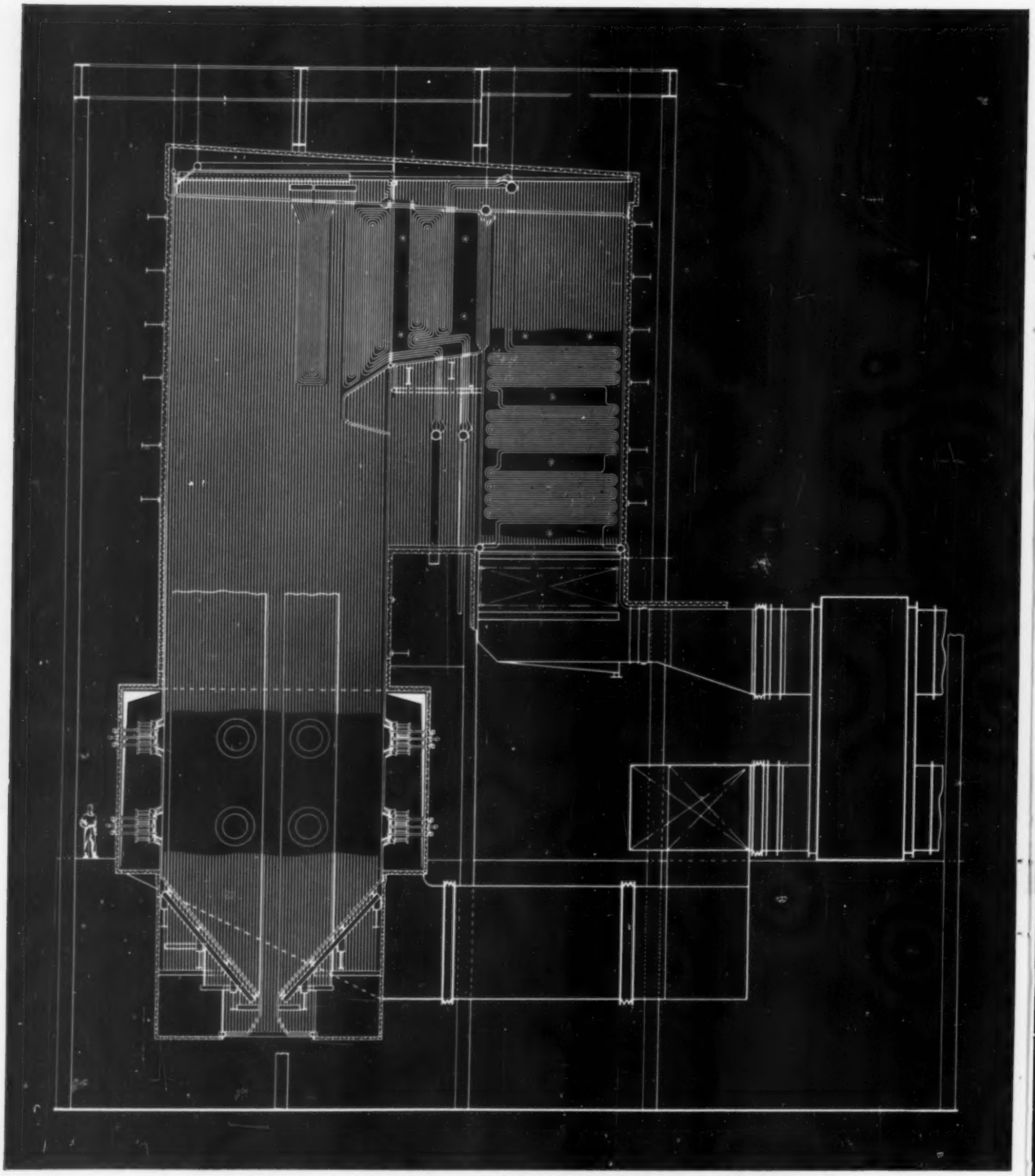
U.S. ELECTRICAL MOTORS INC.

P. O. BOX 2058, LOS ANGELES 54, CALIFORNIA
OR MILFORD, CONNECTICUT

FREE COLOR BROCHURE
...for full information send for FREE Lubriflush Bulletin.

For more data circle 525 on Post Card

A Big Step Forward–



Newest UP unit for Southern California Edison will provide steam at a rate of 1,638,000 lb per hour to a 210,000 kw turbine at a pressure of 2,400 psi and at a temperature of 1,050/1,000 F. Completion of the unit, which will burn either natural gas or oil, is scheduled for November, 1960.

Why Southern California Edison Purchased B&W Universal Pressure Boiler for 2400 PSI Operation

Once-Through Unit Reduces Capital and Operating Costs —Makes Use of Variable Pressure Possible

A big forward step in holding the line on the cost of producing electricity was taken by Southern California Edison in purchasing two B&W Universal Pressure units for its station at Huntington Beach, California.

Solid savings both in installed first cost and in operation stand behind this decision. Here are the facts:

INSTALLED COST

1. The overall cost of a Universal Pressure Boiler represents a saving over a drum type boiler for identical conditions.
2. Because height and weight of the UP Boiler are much less than those of drum type boilers, there are worthwhile savings in building and construction costs.
3. Superheat, hot reheat and cold reheat steam piping are reduced.
4. Foundation costs reduced because of 650 ton saving in weight of unit.
5. Drum transporting and lifting costs eliminated.
6. One level of stairs, walkways and elevator landing eliminated.

OPERATION

Many significant advantages from the UP's unique operating features helped shape Southern California Edison's decision. Here is what they found:

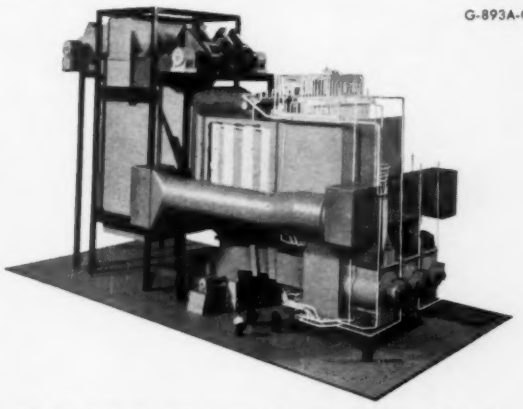
1. Constant steam temperature at all loads without use of tempering equipment.
2. Rapid response to load change.
3. Quick start up and shut down.
4. Simplified control system during normal operation.
5. Minimized operating complications when turbine is tripped.
6. Complete flushing of preboiler and boiler system is accomplished during every start up and shut down.
7. Reduced dependence on safety valves.
8. Elimination of water level gauge glasses and indicators.
9. Ease of acid cleaning.

The Universal Pressure Boiler helps the utilities' pressing need to hold the line on most of the important factors affecting cost of power generation.

Behind its many benefits stands the concrete performance of America's first successful commercial application of the Universal Pressure principle at the Philo Plant of the Ohio Power Company on the American Electric Power System. This unit has had a full year of performance under diversified conditions. Performance, ease of operation and freedom from major troubles have exceeded even the optimum original expectations.

We would be glad to discuss with you the advantages that the Universal Pressure Boiler can bring to your plant. Write to The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

G-893A-CS



Model of the first Universal Pressure Boiler, which is now operating, uses once-through principle by which water, under pressure, is forced in one end of the system and emerges at the other end as superheated steam. This principle eliminates need for a drum.

BABCOCK & WILCOX

BOILER DIVISION

For more data circle 526 on Post Card

BERGEN GETS 8 LJUNGSTROMS® ...AND SOME REMARKABLE CUSTOMER SERVICE

Public Service's new Bergen Generating Station will be served by 8 large, horizontal Ljungstroms. Almost as important . . . the Ljungstroms will be serviced *throughout* their life by Air Preheater.

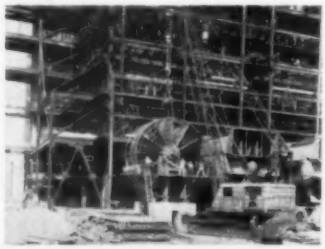
What's special about this customer service? For one thing, it's the considerable knowledge and talents of Air Preheater's engineers. They have been involved in nearly every conceivable type of boiler/preheater problem. They've seen how these problems can be handled. And they can put this experience to work for operators of Ljungstrom air preheaters.

Your Air Preheater engineer also makes regular calls to check the operation of every Ljungstrom – for as long as it's in service. (This now includes installations dating back to 1923.)

So, when you select a Ljungstrom, you're never entirely on your own. You *continue* to be the responsibility of a competent Ljungstrom engineer and benefit from his experience and knowledge. Maybe that's why 9 out of 10 preheaters sold are Ljungstroms.

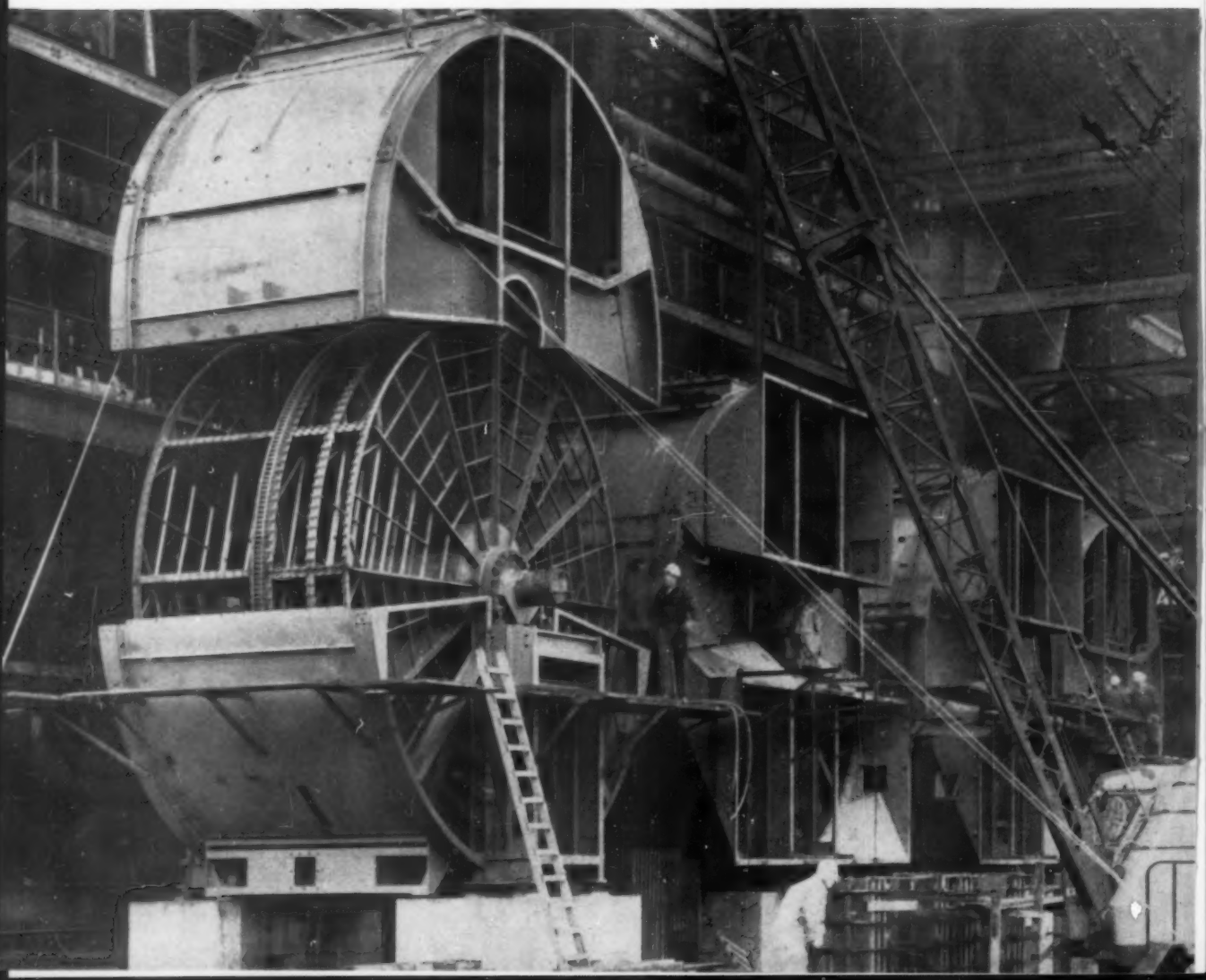
Thirty-five tons of Ljungstrom rotor being lowered into place at the new Bergen Generating Station at Ridgefield, N. J. (When the heating elements are installed the rotor will weigh 150 tons.) This is one of eight preheaters being installed by Public Service Electric and Gas Co. to serve two boilers – each evaporating 1,900,000 lbs of steam/hr. The first boiler is to be fired early next year. Anticipated preheater outlet temperature is about 275 F.

Public Service is one of the first Northern utilities to use large-size horizontal preheaters. They have nine such horizontals in operation at their Linden Generating Station and have ordered eight more for their new Mercer Generating Station.

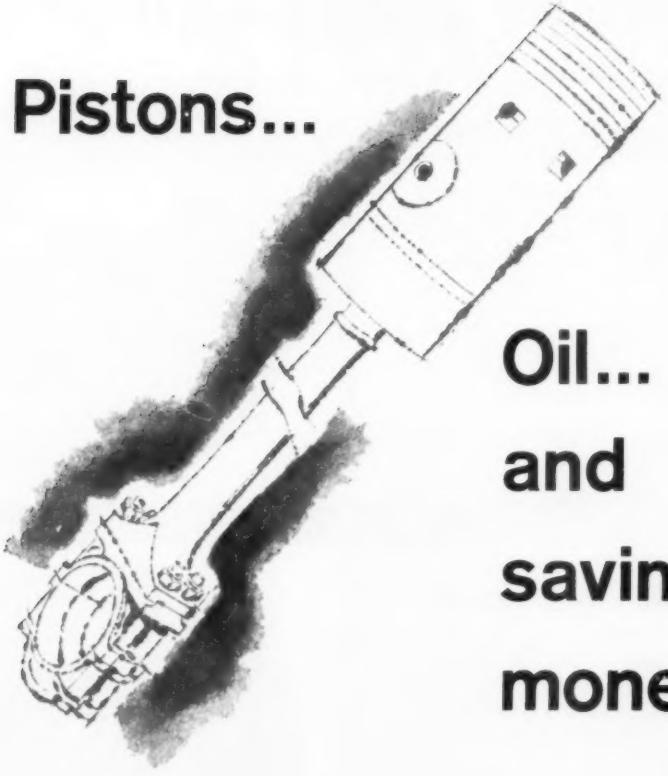


THE AIR PREHEATER CORPORATION

60 East 42nd Street, New York 17, N. Y.



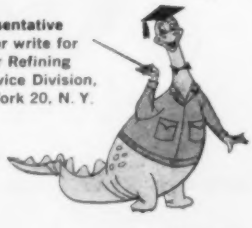
Pistons...



Oil... and saving money

The longer your pistons work before need of ring replacement—the less your cost of operation. Sinclair Rubilene® Oils have the reputation for giving longer service to cylinders, rings and other vital parts. Refill with Rubilene now. Next time management asks how you've cut costs, tell them you've switched to Sinclair—and show them the results.

Call your Sinclair Representative for further information or write for free literature to Sinclair Refining Company, Technical Service Division, 600 Fifth Avenue, New York 20, N. Y. There's no obligation.



SINCLAIR
Rubilene® Oils

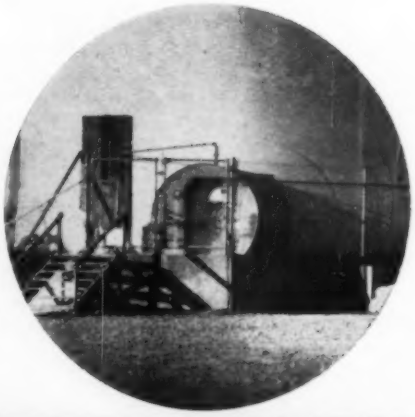
For more data circle 528 on Post Card

Nuclear power plant equipment

Personnel Air Locks meet AEC Code

G. E.'s Vallecitos BWR is one of eight atomic power plants that have installed or are planning to use Henry Pratt Air Locks. Pratt's experience in this field has developed a basic unit that can be modified for any reactor vessel. The Henry Pratt "door" includes some very desirable features . . . an interlocking device that keeps one door open when the other is closed, automatic or manual controls and choice of compression or pneumatic door seals. Locks are built to withstand any practical pressure, size is no problem, an 8'x10' lock at G. E.'s Test Reactor at Vallecitos will admit trucks.

Write for full details.

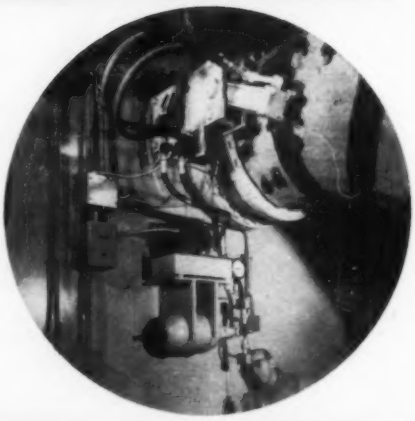


Butterfly Valves that shut in 3/10 of a second

At the MIT Research Reactor two 30" Pratt Quick Acting valves are used in the ventilating system. Their split-second closure is necessary to maintain the integrity of the protective vessel in case of reactor incident. The valves are oil cylinder operated and were shipped complete with a "power package" for easy installation.

These *standard* Pratt valves were chosen for abnormally severe service . . . excellent evidence why Pratt valves are so widely used for handling large volumes of water in condenser service, pump discharge or other power plant applications.

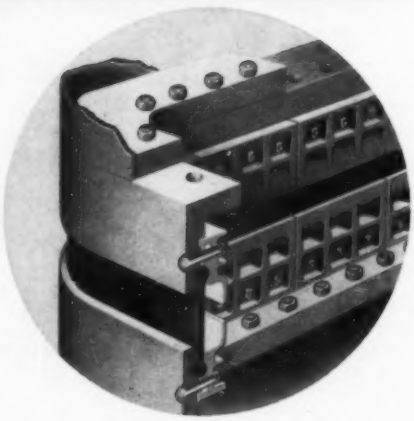
Write for valve manual B-2. G



Expansion joint simplifies turbine condenser alignment

This rubber belt expansion joint provides a flexible, vacuum tight connection between the turbine and the condenser—and greatly reduces time, trouble and costs in engineering and construction. A reasonable tolerance can be allowed because the Pratt Expansion joint absorbs up to 1" of axial and ½" of lateral movement. Round or rectangular units can be built to any size. If one dimension is less than 14'9", the joint can be shipped fully assembled.

Write for Bulletin 5. G



HENRY PRATT

Henry Pratt Company, 2222 S. Halsted St., Chicago 8, Ill.

For more data circle 529 on Post Card

ATOMICS

A section of POWER ENGINEERING covering current and forthcoming developments in the field of Nuclear Power throughout the world

ANDREW W. KRAMER
Editor

CONTENTS

Project Sherwood 43
A brief note on Amasa Bishop's book on the U. S. Atomic Energy Commission's work on the the problem of harnessing the energy of thermonuclear reactions.

Atomic Power Development at Westinghouse 44
A description and analysis of six major reactor development programs underway at Westinghouse. These include advanced types of pressurized water reactors such as that for the Yankee Electric Co at Rowe, Mass., the pressure-tube type of reactor under study for the Carolinas-Virginia group, a new organic moderated fluidized bed reactor concept, and a thermoelectric type of nuclear reactor which would produce electrical energy directly from heat without the need for steam generators of turbine-generating equipment.

Test Assembly for Nuclear Powered Aircraft 50
First description of a test unit developed by General Electric to determine the feasibility of using nuclear reactors for aircraft propulsion. This heat transfer experiment was conducted at the U. S. Atomic Energy Testing Station at Idaho Falls during the year 1956 and proved highly successful. It uses a direct air cycle to which propulsive thrust is provided by sending air from a compressor directly through the reactor into the turbine.

New Nuclear Literature 52

PROJECT SHERWOOD

AS REPORTED IN POWER ENGINEERING last month, an important feature of the Geneva Conference in September was the United States government's presentation to the official delegates of a set of 13 volumes containing virtually the complete American nuclear technology to date.

While all of these volumes are intended primarily for specialists, one book should be of keen interest to the informed layman as well, since it provides a nontechnical report to U. S. research toward the goal of achieving control of thermonuclear reactions. This book, "Project Sherwood" for the first time, presents a detailed account of the quest undertaken by the U. S. Atomic Energy Commission for harnessing the energy of thermonuclear reactions. It is the first unclassified report, written to be intelligible to the general reader as well as to scientists and engineers. The author, Amasa Bishop, formerly was Chief of the AEC Controlled Thermonuclear Branch, and he has been in close contact with the program since its beginning. He is thus able to present a factual and readable account of Project Sherwood—the search for a means of harnessing the almost incalculable power latent in abundant fusion fuels.

Graphically illustrated with over 30 three-color drawings, Dr Bishop presents a compact account of the controlled thermonuclear effort in the U. S.—its origin, its development, its problems, and its eventual success. Beginning with the basic principles involved in a fusion reaction, the various methods now being studied to control thermonuclear energy with the hope of eventually producing net power, are described. These concepts are known as pinch, stellarator, magnetic mirror, and molecular ion ignition. Others, in a somewhat early stage of development, are the Astron, shock-wave, and cusped-geometry approaches. The common characteristic of all these approaches is to heat deuterium gas to very high temperatures (400 million C and higher) and confine the resulting "plasma" long enough for a self-sustaining fusion reaction to occur. Magnetic fields are invariably used to confine the plasma, since material vessels could not withstand the enormous temperatures reached.

The various techniques and approaches in this field of thermonuclear research bear out what is indicated in the review of the Handbook of Physics on page 52 of this issue of ATOMICS, i.e., that much research progress depends considerably on the utilization of advances in one part of the field to provide the means for solving problems in another. Those working in the thermonuclear field today are utilizing many of the principles and ideas of electrical engineering which have accumulated over a period of many years. The pinch effect for example was first discovered many years ago in the development of electric furnaces, where fluid conductors were involved. Now, in thermonuclear research, this same effect is being utilized in the work with gaseous conductors. In this way, by building on the work of others, science moves forward.

Andrew W. Kramer

Atomic Power

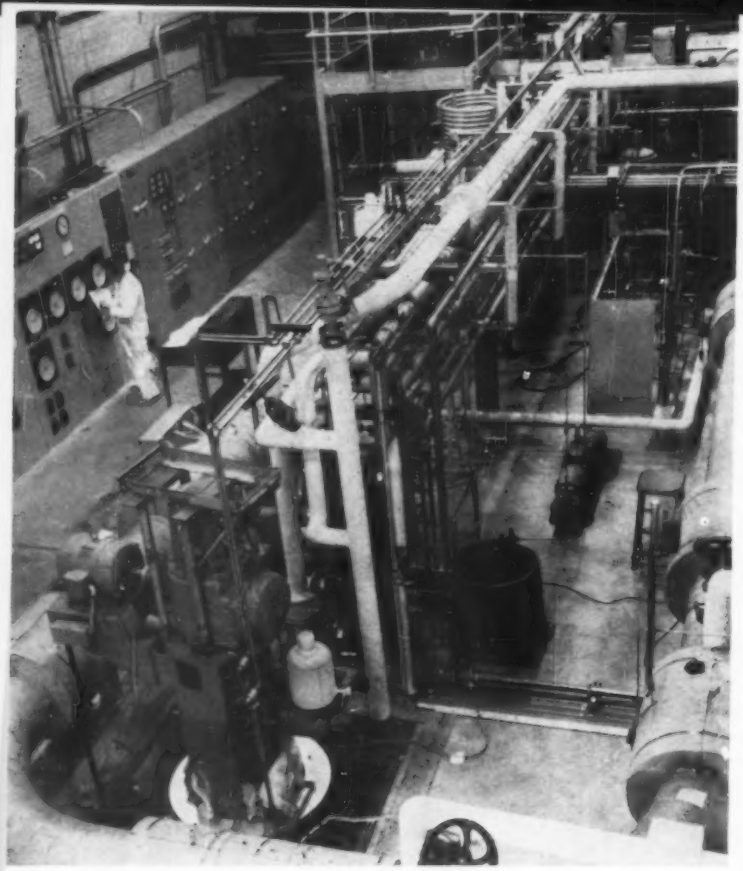


Fig. 1. The world's largest test loop for homogeneous reactors. This giant piece of plumbing is a test loop for circulating a slurry of atomic fuel—uranium oxide and Thorium suspended in water. It is capable of circulating 4000 gpm at the same pressures and temperatures planned for an aqueous nuclear power plant now under study jointly by Westinghouse and Pennsylvania Power and Light Company

AT A TWO-DAY technical conference held at Pittsburgh on October 20 and 21, Westinghouse Electric Corporation disclosed work on new reactor design concepts which are part of six major development programs underway at its Atomic Power Department. These development programs all have one primary goal — the achievement of economic power from the energy of the atom.

The major programs now under way include the pressurized water reactors for the Yankee Electric Company at Rowe, Mass., and the Societe Cooperative Electro Nucleaire at Mol, Belgium; a pressure tube reactor for Carolinas-Virginia Nuclear Power Associates; and a homogeneous reactor for Pennsylvania Power & Light Co. Foremost among the new reactor design programs is one involving the use of thermoelectric materials in the reactor fuel so as to convert the heat of splitting atoms directly into electricity. Another very interesting design makes use of an organic moderated fluidized bed in which control rods are not necessary, the fuel being in the form of pellets no larger than marbles, floating in oil.

This conference at Westinghouse marked the anniversary of the Company's first decade in the atomic power business and the second decade in the field of nuclear research. As C. H. Weaver, vice president, in charge of atomic power pointed out at the opening session, it was just 20 years ago that the world's first industrial atom smasher was placed in operation at the Research Laboratory. This was the first large Van de Graaf generator to be built for nuclear research. The year was 1938. This was also the year in which the Westinghouse Time Capsule was buried at Flushing Meadows at the New York World's Fair. As Mr. Weaver said, it is an indication of our tremendously rapid technological progress to note that the Time Capsule contained nothing about atomic power, although scholars diligently included everything of importance in that day to seal up for the edification of man 5000 years from now.

Power Is Their Business

Power, Mr. Weaver emphasized, is Westinghouse's business — it has been ever since George Westinghouse founded the company in 1886. Therefore, their work in the atomic energy field has been directed toward the development, design, nd manufacture of apparatus which produces power. They have no interest in building research reactors, nor in the volume production of basic materials or chemical reprocessing. Ever since it was decided that the submarine was the likeliest initial application for harnessing atomic energy, the direction of the Company has been set toward the development and production of power reactors. The development of atomic power has brought Westinghouse one principal new product — the nuclear steam generator. The development of the nuclear steam generator as a major Westinghouse product over the past ten years has resulted in an atomic power organization of more than 7000 people, over 1600 of whom are engineers and scientists. At the present time the Atomic Power Department is using the facilities at Forest Hills which formerly housed the Research Laboratory.

A new facility is Waltz Mill. This is what might be called the Company's reactor experiment station. It is located on an 830 acre site near Pittsburgh and involves a Testing Reactor and the Reactor Evaluation Center. This facility is now under construction and will go into service in 1959.

Factors Involved in Reactor Development

In describing the reactor development program, Dr. W. E. Shoupp pointed out that the most important job in any advanced development program is to know what to develop. This, in the case of reactor development, could be a random process, but if this method was used it would be necessary to cover all possible types. Such a program would not only be too large for any company but it would be too large for any country. It, therefore, becomes necessary to select from the many possible types those that are the most feasible and those that will satisfy the criteria of the user. We must guard against the selection of reactors just to be different rather than good.

In reactor design, the most important variables that have to be selected are three in number: the moderator, the fuel, and the coolant. The moderator is the material which slows down the neutron to make it more effective. The fuel, of course, supplies the energy, and the coolant transports the energy or takes it away. It is necessary also to specify the neutron characteristics of the reactor to determine whether it will be a burner, a converter, or a breeder.[1]

Now the moderators can be at least six in number or none at all. With no moderator we have a fast reactor. Where a moderator is used, we can use carbon, beryllium, light

Development at Westinghouse

Westinghouse discloses six major reactor development programs underway. These include advanced pressurized water types, pressure tube reactors involving nuclear superheating, as well as two radically new concepts, one using a fluidized solid fuel type of bed, and the other, thermoelectric elements for direct conversion of heat into electricity. Homogeneous reactors are also being developed

water, heavy water, or an organic material. For fuel, there is a choice of natural uranium, slightly enriched uranium, U-235 uranium-thorium mixture, uranium-plutonium or plutonium itself. Then, for coolant, we have ordinary water, heavy water, sodium, an organic liquid, gas, or steam.

It will be obvious that with this large number of variables, the possible number of different reactors that can be designed is very large — at least 1200, using only these three sets of variables, but there are other factors which make the number even larger.

From a practical standpoint, however, the real criteria of selection should be only two in number — small power cost and the fuel availability. On a short term basis — and by a short term basis is meant a period of some 20 years — power cost should be the only criteria. Power cost is simply mills per kwh. What influences the mills per kwh is the capital cost, the fueling cost, and the operation and maintenance cost.

With so many variables it is to be expected that no plant can be best for all sizes, all locations, or all calendar times. Particularly, there is no one plant best, because in all sizes certain plants cannot be scaled up to indefinite sizes because of limitations in both the primary and secondary component size. As Dr. Shoupp indicated, it may be impossible to construct or to ship, or even to make components for certain very desirable reactors in enormously large sizes. Fuel costs vary radically for a given size. Technical know-how to operate and maintain a plant varies from location to location. The fuel availability is certainly different in the United States than it is in other countries. The shock and earthquake problem is different for different types of plants and for different countries and different regions in the United States. As to time, if plants that used U-235 had to provide all the power at the 1975 level, this fuel would provide it only for ten or twenty years. We must, therefore, plan to convert or breed on a long term basis.

There is another variable and this relates to the accounting system. Depreciation rates vary all the way from zero to 40 years. Zero for some prototype or experimental plants — 40 years for other systems. At Westinghouse, they have analyzed some 50 types of reactors and from the results of this study, six have been selected as showing definite promise. These form the basis of the advanced development program. These six reactor types are as follows:

Advanced PWR
Pressure Tube — CVTR
Boiling Superheat — IBSHR
Organic Fluid Bed — OMFBR
Thermoelectric
Homogeneous — PAR

All of these reactor types are subject to certain limitations, involving fuel, capital, operation and maintenance, fabrication, cycle time, and other factors, and it is the object of the Westinghouse atomic power program to compare these various limitations in evaluating the merits of the different reactor types. The program as a whole can be divided into three parts: 1 improving existing types to solve the limiting problems; 2 evaluating by means of prototypes a few promising new types; and 3 developing certain high conversion and breeding reactors for the time when existing fuels are depleted.

With respect to item 1, it is felt that the pressurized water reactor should go through a 5th, 6th, and 7th generation. It has already gone through four generations; the Materials Testing Reactor (MTR), the Submarine Thermal Reactor (STR), Shippingport, and the Yankee reac-

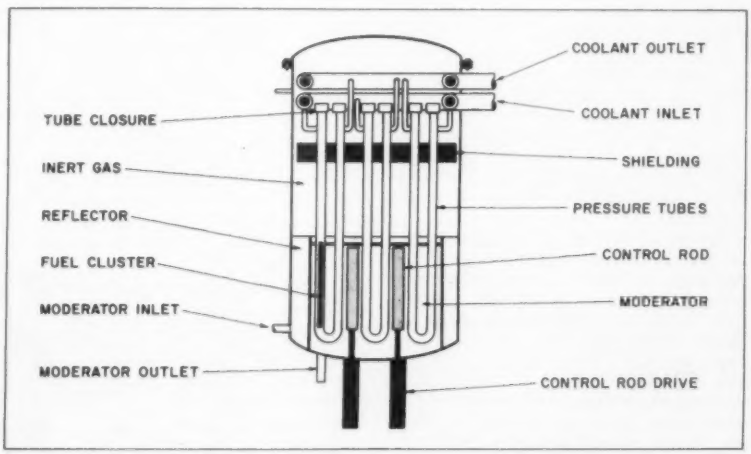


Fig. 2. The Carolinas-Virginia pressurized tube reactor using heavy water as moderator. The latter is contained in an unpressurized tank surrounding the fuel tubes.

[1] In a burner, the fissionable material in the core is burned up until it is depleted to a point where the remainder will no longer sustain a nuclear chain reaction. It is then replaced by a new fissionable material.

In a converter, a portion of the neutrons released in the fission process is used to convert fertile material such as U-238 into fissionable material such as plutonium. This, in turn undergoes fission, and thus the life of the core is extended.

In a breeder this process of conversion of fertile into fissionable material is carried to the point where the reactor actually produces more fissionable material than it consumes. Thus, it is called a breeder type of reactor.

ATOMICS

Fig. 3. The site of the Westinghouse testing reactor at Waltz Mill, Pa. The primary purpose of this reactor will be to subject materials and nuclear fuels to radiation similar to those encountered in nuclear power plants.

tor now being constructed at Rowe, Massachusetts. Due to th considerable technical knowledge developed in the design and operation of these first four generations it is now possible to see the future more clearly for this reactor type than for any other — what major improvements can be made and what they will cost. It is believed that the suggested improvements, verified by research and development, can make the fifth generation of the PWR type capable of delivering competitive power in most areas of the world and in certain high cost areas of the U.S. These improvements can come about by increasing the fuel loading, the fuel cycle time, the power output, and the direct modifications of the Yankee plant.

While the Yankee plant is a pressurized water plant similar to Shippingport, its design incorporates certain differences. It is, of course, larger — 134,000 kw as compared to Shippingport's present rating of 60,000 kw. When the Yankee program was initiated in 1956 a tremendous amount of development work had already been done in connection with Shippingport, and the trend toward lower power costs dictated significant improvements in core design and efficiency. As an important example, nucleate boiling is to take place at the heat transfer surfaces of the fuel elements. This is an important difference between Shippingport and Yankee; in the Shippingport core there is no boiling. Boiling, since it involves the latent heat of steam, greatly increases the heat transfer rate.

The core and fuel element problem was a problem requiring major research in developing a stainless steel element containing pellets of slightly enriched uranium oxide. This work is being supported by the AEC on a contract with the Yankee Electric Company and, in turn, with Westinghouse. Extensive core physics calculations and critical experiments have confirmed the choice ofstainless stee las a cladding material. Timing on this development program calls for final decisions on the core by the end of this calendar year.

Belgian Reactor (BR3)

A small, light water reactor is being built for a government laboratory located at Mol, Belgium. This will be a 10.5 Mw plant using many of the same features included in the Yankee design. The core, as in the case of Yankee, consists of stainless steel tubes containing uranium oxide pellets. This plant is well along in construction. It will be used primarily for the purpose of training Belgian utility people and also for the purpose of obtaining experimental information on this type of reactor. The Belgian reactor is the fifth generation of the pressurized water plant.

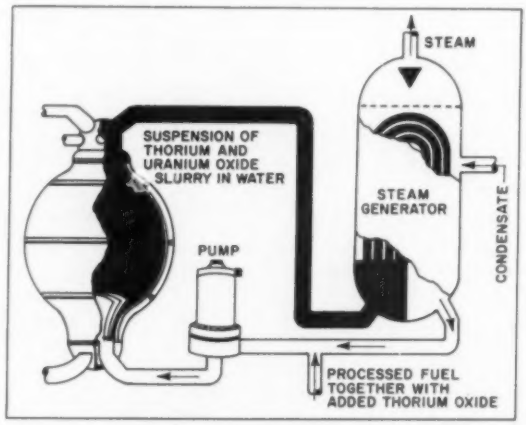


Fig. 4. The Homogeneous reactor using a suspension of thorium and uranium slurry in water under study by Westinghouse and Pennsylvania Power and Light

Carolinas-Virginia Tube Reactor

In the search for more economical nuclear power, two of the major limitations of the *conventional* pressurized water system become evident. These limitations are: 1. the size of the pressure vessel, and 2. one fluid is used as both coolant and moderator. Therefore, Westinghouse is carrying on a major program for the Carolinas-Virginia Nuclear Power Associates to develop a significantly modified and improved type of water reactor. The idea involved in this reactor is shown in Fig. 2. It contemplates the replacement of the single large pressure vessel by a group of relatively small tubes which carry the high pressure heat transfer fluid. The moderator, which is simply contained in a large unpressurized tank surrounding the fuel tubes, will be heavy water to achieve better neutron activity. The high pressure coolant which will circulate through the tubes has not yet been established; currently several possible choices are being studied.

The contribution of the CVTR tube reactor is to improve the fabrication, the cycle time, and particularly the conversion gain. The complexity of the plant is somewhat increased, due to the use of heavy water, and the complexity of the auxiliary systems is certainly increased. The safety and output level are still good, and the size and control improved. The cycle time, the routine shutdown, and the non-scheduled shutdown are improved markedly because the fuel can be changed very simply. The moderator is heavy water, and this is a disadvantage because of its cost. The output level and size is significantly improved.

This sixth generation PWR plant, however, still has one or two limitations. It is still not a high efficiency plant, and it still may be limited in size due to its low steam pressure which determines the size of the equipment necessary for the secondary or conventional equipment.

The seventh generation pressurized water plant is the integral boiling superheat reactor (IBSHR). This plant is a modification of the CVTR pressure tube plant. The cold water is taken into the center section tubes where it is allowed to boil, taken out of the reactor to the steam separator if this is necessary, taken back into the outer layer of tubes for superheating of the steam, and then to the

Fig. 5. (Below) Wood and plastic model used to study equipment replacement and remote handling procedures for the maintenance of reactors of the homogeneous type

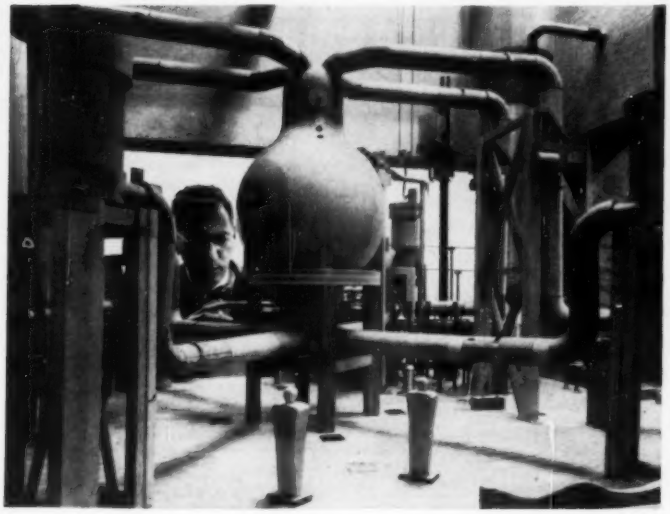


Fig. 6 (Above) Techniques for remotely dismantling and assembling equipment are under development. Here a technician uses a servo-manipulator to take a pump apart.

turbine. This system, shown in Fig. 7, has the advantage of high efficiency and is not limited in output in the secondary, or the primary system by the size of the components and pieces that can be manufactured. As in all direct-cycle plants, it would suffer from the deficiency that a serious failure in fuel elements exposes the turbine, condenser and feed water systems to the radioactive fuel in the failed fuel elements. It is felt at Westinghouse that it will take a great deal of time and effort to prove that it is possible to protect the secondary part of the system from a high degree of failure of fuel elements in the system, nevertheless, it may be possible on a long term basis.

Pennsylvania Advanced Reactor

In studies of the possible types of nuclear reactors, the aqueous homogeneous type of reactor was selected in 1955 as having important long term promise. This type was chosen because of its low fuel cost, its continuous fuel reprocessing possibilities, and its ability to create new fissionable fuel.

This program was initiated as a private venture supported jointly by the Pennsylvania Power & Light Co and Westinghouse. After two and one half years the AEC indicated a willingness to support the continuing research and development program in order to improve the possibilities for a plant of this type being built. A decision as to the construction of a plant of this type will be made by the end of 1959 — after 4½ years of a large-scale development program.

Basically, the homogeneous reactor continuously circulates a fluid fuel in a high pressure loop through the reactor vessel and a heat exchanger. This liquid fuel is a slurry containing particles of uranium and thorium oxides suspended in heavy water. Solid fuel elements, which are inherently expensive to fabricate and require periodic shutdown for replacement, are eliminated. The liquid fuel in the homogeneous reactor can be reprocessed and purified continuously without affecting operation.

An extremely important long range feature of the homogeneous reactor is its ability to create new fissionable fuel. Some of the neutrons born in the fission process convert the thorium to uranium-233, which is fissionable. Thus, it is possible to make almost as much new fissionable uranium from the relatively inexpensive thorium as is needed to keep the reactor in operation.

The pressure vessel is a steel sphere. This shape, in combination with a carefully selected composition of liquid fuel, or slurry as it is called, permits a critical mass but limits it to the pressure vessel itself. Heat which is generated as a result of the fission reaction in the critical mass, is continuously transported to the heat exchanger as the slurry is pumped through the system. While the aqueous homogeneous reactor is basically simple in concept, it has numerous difficulties. Some of the problems are common to all reactors to some degree, but others are rather unique. The chief problem concerns the necessity for remote maintenance. The radioactive fuel itself passes through the reactor vessel, the heat exchanger, the pumps, and the piping. Thus, the entire system becomes highly radioactive. Therefore, the entire system must be maintained by remote means. The problems involved here are quite astonishing. Methods must be provided for taking down every piece of pipe in entire system by remote handling mechanisms; means must be provided for cutting valves and fittings from the piping by remote flame cutting equipment and rewelding these components back into the system. Servo-manipulators must be provided to remove bolts and unscrew nuts, and for dismantling pumps and other devices in the system.

To solve this very difficult problem a wood and plastic scale model of the homogeneous plant has been set up to study the placement of all equipment for accessibility by the remote handling apparatus. To date methods have been worked out whereby ten-inch steel valves and fittings have been cut from completely welded lines and welded back into place entirely by remote operation.

Other problems concern the physical and chemical behavior of the slurry. Laboratory studies include complete analysis of the properties and behavior of slurry. On a larger scale, slurry has been pumped for 35,000 hours in several high temperature and high pressure test loops that simulate reactor operation. The largest of these loops, built for the testing of actual components and establishing plant operating procedures, is the largest in the world. The development work on the slurries has proceeded to the point that combined tests on the behavior of the slurry under highly radioactive conditions are in order. An inpile loop has now

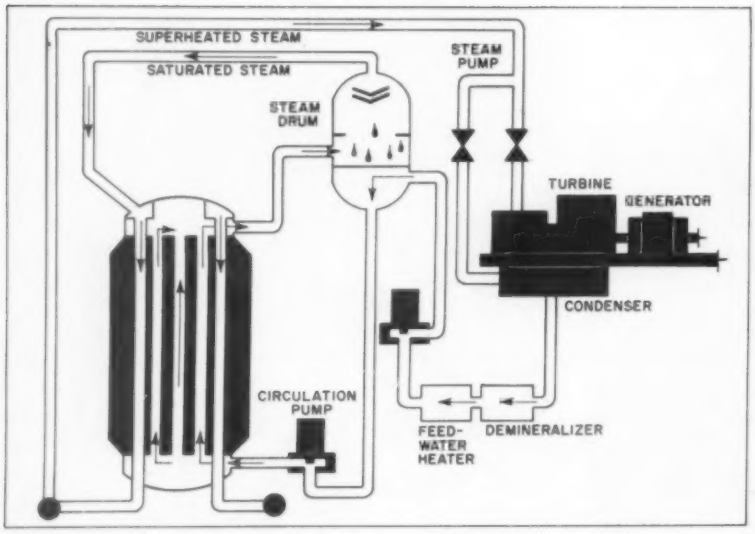


Fig. 7. The integral boiling superheat reactor (IBSHR) using the pressure tube principle combined with nuclear superheating

been constructed and this will be transported to Oak Ridge where it will be inserted into the test reactor there for irradiation under flow conditions.

Fluidized Bed Reactor

Thus far, the reactors under consideration have all been of types closely related to systems actually in use or on which considerable research has been done. Now, two reactor concepts will be considered which are only in the idea stage. The first of these is the organic moderated fluidized bed reactor (OMFBR). In this reactor system, Fig. 8, the fuel is in the form of uranium oxide pellets, cheap and easy to fabricate. The pellets are clad with a very thin layer — a few microns — of any material which seems suitable for chemical reasons, because so little of it is needed. The bed is fluidized, that is, the flow of the fluid expands the bed of fuel and thus turns the reactor on. The coolant and moderator is an organic material. The designers of this system propose to use diesel oil for this coolant and moderator since this is inexpensive, and it can be purified continuously by the proper design of the bleed and feed system. In this case, fabrication costs are low, cycle time excellent, there are less nuclear poisons, no costly exotic materials, the safety and size are very good, and the shutdown characteristics of the plant should be excellent.

The Thermoelectric Reactor

Perhaps the most fascinating of all, is the thermoelectric reactor concept because in this system it is proposed to discard the entire steam system and to remove the electric power from the reactor directly by means of the thermoelectric effect.

As is well known to any student of physics, the phenomenon of thermoelectricity dates back to what is known as the Seebeck effect, discovered in Germany in 1821. Seebeck found that an electric current flows continuously in a closed circuit composed of two dissimilar metals as long as the junctions of the metals are maintained at different temperatures. The action of the familiar thermocouple depends upon this principle. In other words, the thermocouple is a device for converting heat energy directly into electricity.

Unfortunately, the efficiency of the thermoelectric effect has been low, and the voltage produced extremely small — a few millivolts for a difference in junction temperatures of 100 F. However, by connecting a number of thermocouples in series higher voltages can be obtained.

It is obvious, therefore, that if a reasonably efficient thermocouple can be developed it becomes possible to convert the heat in a nuclear reactor directly into electric power, and this is the principle involved in the thermoelectric reactor proposed by Westinghouse. For example, if a fuel such as a mixture of uranium and uranium oxide were encapsulated in a thermoelectric material of, say, type A, and an adjacent fuel element were encapsulated in a material of type B, and if a number of such elements were hooked in series, the heat produced in fuel by virtue of the critical mass would be converted directly into direct current electricity.

Recently scientists at the Westinghouse Research Laboratories have discovered a number of compounds in a previously unexplored class of solid state thermoelectric materials which appear to make feasible the interchange of heat and electricity at the high temperatures encountered in standard methods of power generation. At the same time, the materials

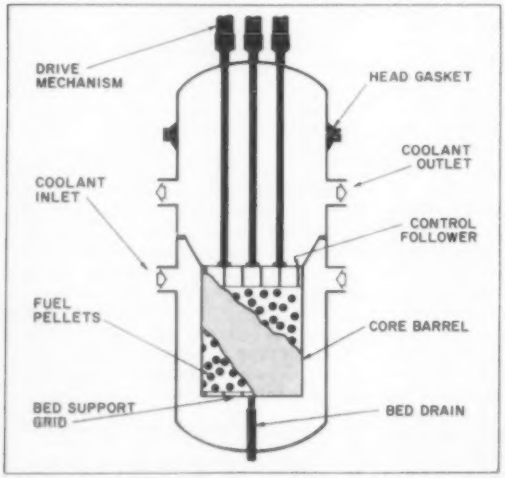


Fig. 8. The proposed organic moderated fluidized bed reactor using inexpensive uranium oxide pellets as fuel

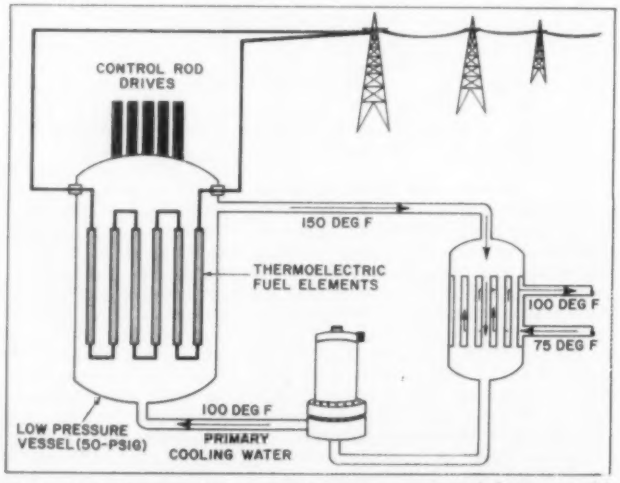
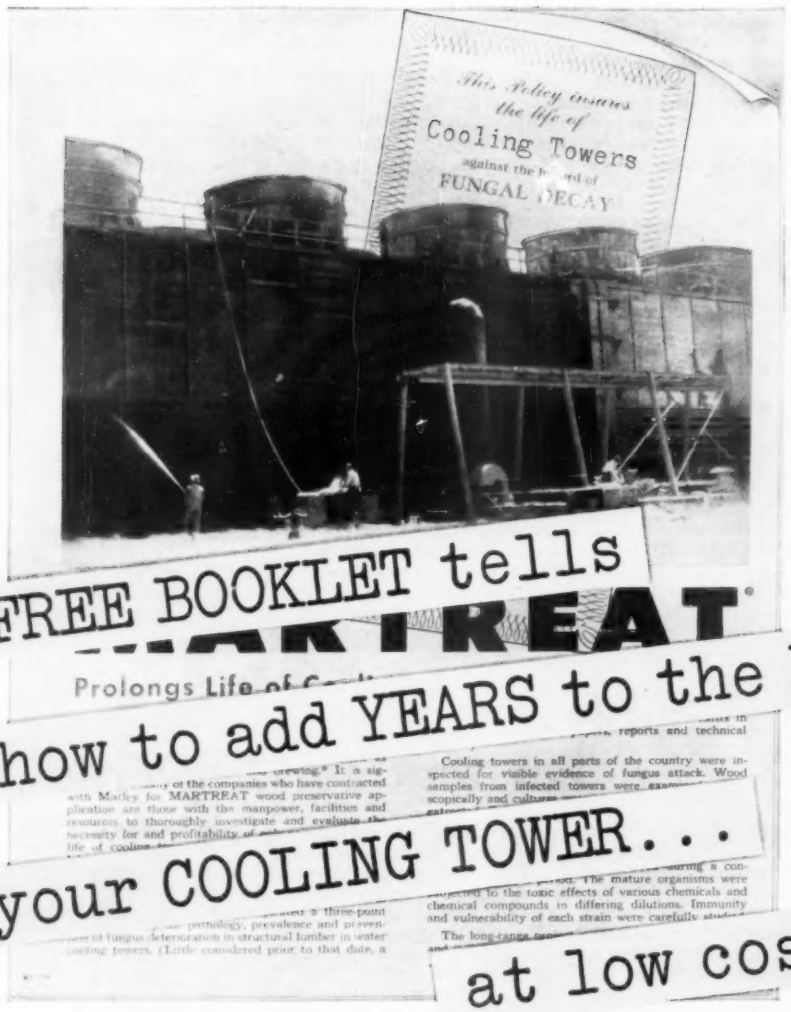


Fig. 9. In the thermoelectric reactor heat energy of fission would be converted directly into electricity by the thermoelectric effect.



NEW FREE BOOKLET tells how to add YEARS to the life of your COOLING TOWER... at low cost!

Marley's exclusive MARTREAT® process is the *proven* way to halt fungal decay and add years to the life of your water cooling tower—and it can be economically applied to any cooling tower now in service, regardless of age or make.

A new informative Martreat Bulletin sums up Marley's years of leadership and experience in preservative wood treatment for cooling towers—pinpoints the organisms that destroy the effective performance of your tower and eat away your investment . . . prescribes the treatment that arrests these destructive organisms, and its application techniques . . . demonstrates the efficacy of the Martreat process . . . documents industry's wholehearted acceptance of this unique wood preservative treatment.

Only Marley can offer you this form of "cooling tower life insurance" backed by successful treatment of more than four million board feet of cooling tower lumber for the country's largest industrial organizations (name list available) in the petroleum, power, chemical and food processing industries. Write today or ask your Marley representative in any of 56 cities for the new MARTREAT BULLETIN MT-58.

Also available—descriptive folder on Marley's complete engineered reconstruction services

MARLEY

The Marley Company

Kansas City, Missouri

For more data circle 530 on Post Card

are chemically inert, rugged, readily available, and inexpensive. These materials seem to lend themselves favorably to use in a nuclear reactor since the higher the temperature the more effective they are. In a reactor we have a fuel, uranium oxide, which has a melting point of some 5000 F. In the fission process, thermal energy is generated at millions of degrees so in the thermoelectric generator the temperature would be limited only by the material.

In the proposed reactor, a series of such thermoelectric fuel elements would be arranged in a container as shown in Fig. 9 and water circulated from the bottom of the tank upwards. This acts as the coolant and moderator. All that is required of the water is that there be a temperature difference. We have a high temperature in the fuel elements, but the temperature difference in the water need be only 50 degrees as indicated. All that is necessary is to expose the fuel to one of the thermoelectric junctions and the coolant to another junction. This generates electricity, provided we have the right type of thermoelectric materials in the reactor.

No Single Reactor

As indicated by Dr. Shoupp, in evaluating the merits of these various reactor concepts, the star performer for the long term future is the homogeneous plant. "If we assume that we must breed or convert to a very high ratio, we must follow either the fast breeder or the thermal-breeder concept. Westinghouse is a party to the PRDC program (Detroit Edison Enrico Fermi Plant), which is a fast breeder project, but our chief aim for the future is the homogeneous slurry reactor. The homogeneous plant is not only a good long term bet, but could also be an intermediate range bet for low-cost power."

Despite the attractiveness of the homogeneous reactor, it is felt that there is no single reactor that is just right for all sizes and locations, or all times. There should be a short range and a long range approach. On the short-range approach we have burners that are of primary value to the military; the converters, for military, marine, and utility. For the long range we must have high converters or breeders and these breeders can be either thermal or fast.

"We believe," said Dr. Shoupp, "that the development programs must be limited but they should amplify improvements to existing types. They should evaluate, through prototypes, a few of the most promising types, and we must develop certain high-conversion reactors or breeders to be used when fuels are much more scarce. For Westinghouse, the plan to accomplish these objectives are: improvements in the pressurized water systems which are the Advanced PWR, pressure tube, and the boiling superheat reactor. Then there are the two new ideas, previously described, the Organic moderated fluidized bed reactor, and the Thermoelectric reactor. The Company's long range efforts are on the homogeneous plant and the fast breeder."

As a guide to this policy, Dr. Shoupp quoted an old Chinese proverb, to wit, Confucius say, "A man is a fool or very hungry who hunts bear with a single arrow in his quiver." THE END

Test Assembly For Nuclear Powered Aircraft

FROM A TECHNICAL standpoint there is little doubt that the most difficult job confronting designers of nuclear power plants is the development of a nuclear reactor for aircraft propulsion. Because of the vital need for such plants in military aircraft, research and development in this field has been underway for many years but until recently nearly all of it has been highly classified. Only within the past few months has specific experimental data been released which provides some measure of the progress being made.

In a paper prepared for the Geneva Conference, tests on HTRE No. 1 (Heat Transfer Reactor Experiment No. 1) were described which proved the operability of the system and the predictability of its performance. HTRE No. 1 marked *the first time* that all the components of a combined reactor and jet engine power plant were assembled and operated.

This system was developed and produced by General Electric Co engineers and scientists at the Aircraft Nuclear Propulsion Department, Cincinnati, Ohio, under dual contract with the U.S. Air Force and the Atomic Energy Commission. The tests were conducted at the National Reactor Test Station in Idaho Falls during the period January 1956–January 1957.

These tests were of great significance in meeting the objective of developing a useful aircraft nuclear propulsion system. The test assembly for the experiment consisted of an air-cooled, metallic-fuel-element, water moderated reactor operating a modified J47 turbojet engine designated X39. The schematic diagram, Fig. 1, shows a simplified version of the air-flow path through the system.

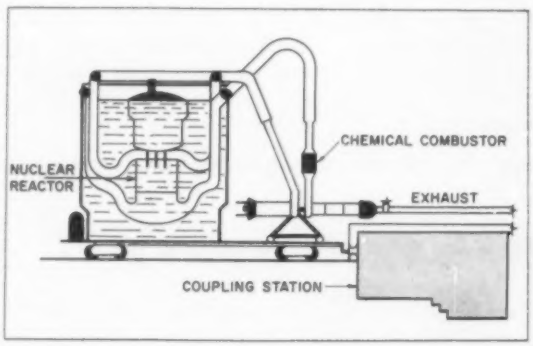


Fig. 1. Test assembly utilizes the direct air cycle to which propulsive thrust is provided by sending atmospheric air from the compressor directly through reactor, into the turbine, and out through exhaust nozzle.

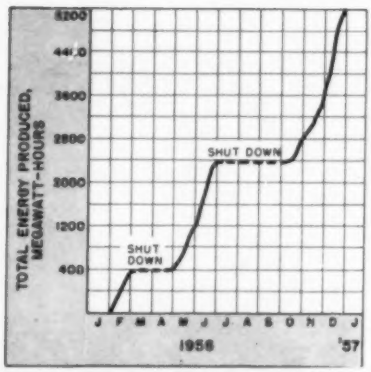
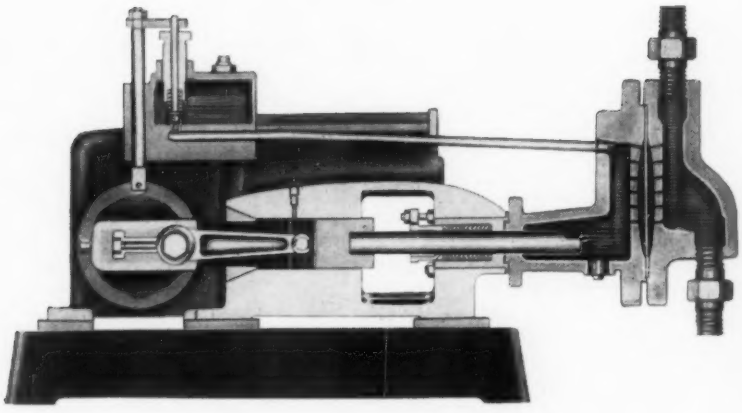


Fig. 2. Range of energy produced by HTRE No. 1.

The reactor core structure consists of a cylindrical water vessel penetrated by air tubes. The shield plug structure and the heavy gamma ray shielding are of stainless steel. Moderator water is used for neutron shielding in the shield plug.

The power plant is started on chemical fuel alone, with compressor air (compressed to 5 times the intake pressure) passing through the cold reactor. As the reactor power increases,

ATOMICS



This diaphragm pump can't air bind

. . . one of many reasons why you get reliability and accuracy with Milton Roy Controlled Volume Diaphragm Pumps

Take a good look at these outstanding features of the new Milton Roy Controlled Volume Diaphragm Pump:

- **no air pockets.**
- **positive mechanical valving bleeds air or vapor from hydraulic fluid automatically once each stroke.**
- **uniform pressure on both suction and discharge . . . diaphragms move without tendency to twist or bend.**
- **non-lubricating hydraulic system . . . fluid can be water, or other liquid.**
- **no moving parts to beat air into the hydraulic fluid.**
- **diaphragm liquid ends interchangeable in the field with Milton Roy packed plunger liquid ends.**
- **monel fillers . . . effectively seal and prevent cold flow of the plastic diaphragm.**

Standard liquid end designs are available for pressures to 1,000 psi and capacities from 1.1 to 138 gph . . . manual or automatic 0-100% capacity adjustment. Higher capacities available.

Take another look at the Milton Roy approach to your metering and pumping problems . . . write for detailed information to Milton Roy Company, 1300 East Mermaid Lane, Philadelphia 18, Pa.

Controlled Volume Pumps • Quantichem Analyzers
Chemical Feed Systems • Anders Air and Gas Dryers

milton Roy
CHEMICAL INSTRUMENTATION SYSTEMS

For more data circle 531 on Post Card

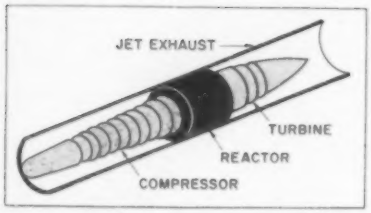


Fig. 3. Potential Nuclear Power Plant

the chemical fuel flow is decreased. When nuclear power is sufficient for self sustaining operation, chemical fuel is cut off. Throughout the tests, operation was stable during the transition from chemical to nuclear power and the reactor was responsive to both manual and automatic control. Combined operating time during the test period totaled 258 hours. A chart showing the total energy produced in the test period is shown in Fig. 2.

Extensive operation at full nuclear power was recorded without failure or significant leakage of radioactive material to the airstream. Proof was obtained that overheating portions of the reactor would not lead to local flow starvation and progressive overheating.

Much of the apparatus in the setup was provided for developmental convenience and would not be used in an actual system for aircraft. The shield, for example, is extra-heavy to allow external contact maintenance during shut-down. In an aircraft installation the shield would be much lighter and the engine would be coupled more closely to the reactor-shield assembly. A diagram of a *potential* configuration for a Direct Cycle Nuclear Turbojet for airframe application is shown below in figure 3.

Research and development has proceeded at an accelerated pace at General Electric since these first tests were made. The great challenge of the aircraft nuclear propulsion project is that this type of system requires generation of large amounts of heat from a nuclear reactor of very small volume. Also, all items comprising the power plant must be provided within very stringent weight limitations. Intensive work has been — and is — under way in areas of reactor design, shield design, and the development of new materials to withstand extreme temperatures and neutron bombardment, as well as new methods of fabricating these materials.

While much progress has been made, many problems must still be solved before the first high performance aircraft flies on nuclear power.

REPRINTS OF ATOMICS

Reprints of the ATOMICS sections from POWER ENGINEERING for the six months from July to December 1958 will be available about the middle of January, 1959. Only enough of these will be printed, however, to take care of advance orders. They will be available at $1.00 per copy. If you want one of these reprints, please fill in the following form, and send it to:

Editor, ATOMICS
c/o POWER ENGINEERING
308 E. James Street, Barrington, Illinois

☐ Enclosed is my $1. Please send me the reprint when ready without further bother on my part.

☐ Tell me when my copy is ready and I'll send you the $1 then.

New Nuclear Literature

Handobok of Physics. In this month's review of new literature in the ATOMICS section we have room for only one book—the Handbook of Physics, just published by McGraw-Hill Book Co. This huge volume, measuring, 8 by 10 inches and 3 inches thick, and having 1504 pages, forms a truly astonishing display of complex scientific knowledge and mental effort. It contains the untold work of thousands of scientists over countless years, and while no single volume could ever contain the whole of what we call physics, this book makes a valiant effort to accomplish it.

As explained by the two chief Editors, Edward U. Condon and . Odishaw, this book was first pla. nearly ten years ago when both men were closely associated at the National Bureau of Standards. They set themselves to the problem of making a judicious selection from the vast literature of physics materials which might reasonably be called, "What every physicist ought to know."

As the planning went forward, they became increasingly aware of the difficult task they had undertaken. The literature of physics has become so great, and is growing at such a rate, that it is difficult for a physicist to be really well-informed on more than a relatively narrow specialty within the subject. Nevertheless the unity of science is such that much research progress depends considerably on utilization of advances in one part to provide the means for solving problems in another. Therefore it is necessary for physicists to make strong efforts to resist tendencies toward over-specialization.

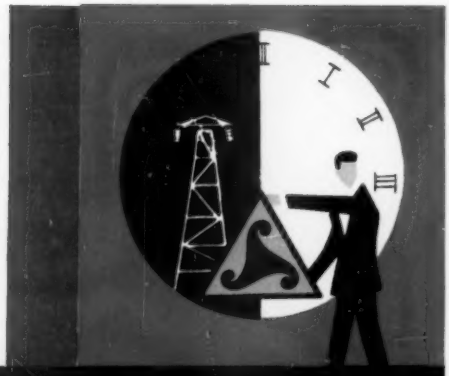
Thus, these two distinguished editors, working with scores of today's most outstanding scientists, present in this handbook a comprehensive and authoritative guide to basic physics. Comparable in treatment scope to handbooks serving other professions, this volume concentrates on principles, ideas, concepts, and mathematical methods of all branches of modern and classical physics. In this volume may be found concise answers to hundreds of questions in the field of physics. In addition, the material serves as a check for better understanding of basic concepts, problems, mathematical formulations and equations, and offers a means of review or gaining an understanding of unfamiliar areas. The emphasis in this thoroughly documented book is on the principles of physical science and the mathematical techniques required for their exposition. Within this framework, the main sections cover mathematics, mechanics of particles and rigid bodies, mechanics of deformable bodies, electricity and magnetism, heat and thermodynamics, optics, atomic physics, physics of the solid state, and nuclear physics, including meson physics.

Contributors of the various sections were drawn from all over the world, from England, Holland, Switzerland, Ireland, India, Israel, and from all over the United States. Regarding the two editors, Dr. Condon is now Professor of physics at Washington University in St. Louis. He was formerly the Director of the National Bureau of Standards. Dr. Odishaw, formerly the Assistant Director of the Bureau of Standards is now the Executive Director of the U. S. National Committee for the International Geophysical Year, National Academy of Science. The Handbook of Physics is published by McGraw-Hill Book Co., 330 W. 42nd St., New York. The price is $25.00.

ATOMICS

Satisfaction at Salem

New unit "On Schedule" for New England Electric



Unit #3 of New England Power Company's* Salem Harbor Station recently went "on the line" on schedule. In a highly successful demonstration of working together in close cooperation, Stone & Webster Engineering Corporation and New England Power Company jointly designed this new 125,000 kw unit. Stone & Webster supervised the construction of this latest unit which makes the complete Salem installation the largest electric power station in the great New England Electric System.

**Part of New England Electric System*

On every project . . . of whatever size and wherever located . . . Stone & Webster engineers keep construction schedules and cost estimates constantly in mind. If you would like to discuss how Stone & Webster's broad engineering and construction experience can help you on your next project, call or write our nearest office.

Stone & Webster builds installation and operating savings into your project through engineering economies and extra plant efficiency.

STONE & WEBSTER ENGINEERING CORPORATION

A SUBSIDIARY OF STONE & WEBSTER, INC.

New York Boston Chicago Pittsburgh Houston San Francisco Los Angeles Seattle Toronto

How Commonwealth Edison Turned a Fly Ash Problem Into Profit

At Commonwealth Edison's State Line Station, about 350 tons of fly ash a day had to be wet down, loaded, and trucked to suitable dumping sites.

Waste becomes profit. Today, the plant burning a peak load of 5000 tons of coal daily collects dry fly ash automatically in a totally enclosed Fuller-Kinyon system. The ash is conveyed from precipitators to storage bins and silos, where it's sold as a by-product. Manpower: just three men, one at the main control panel and two bagging the ash for sales to local contractors.

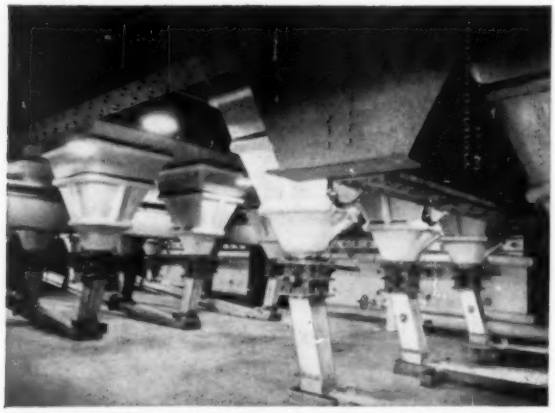
Air and gravity do the work. F-H Airslide® conveyors fluidize dry fly ash by a column of low-pressure air for easy movement by gravity to central surge hoppers. Then, a Fuller-Kinyon pump under each hopper drives the ash by air through a five-inch line to storage. The system is practically maintenance-free. There are few moving parts to foul or wear out.

Large and small plants can get the benefits of Fuller-Kinyon fly ash handling. Capacities range from 100 to 8,000 cubic feet an hour. F-H Airslide and Fuller-Kinyon conveying lines can be curved to avoid beams and other obstacles. Low-pressure air provides power inexpensively and installation costs are significantly less than other types of conveying systems. Write for detailed information in Bulletin FF-49-1.

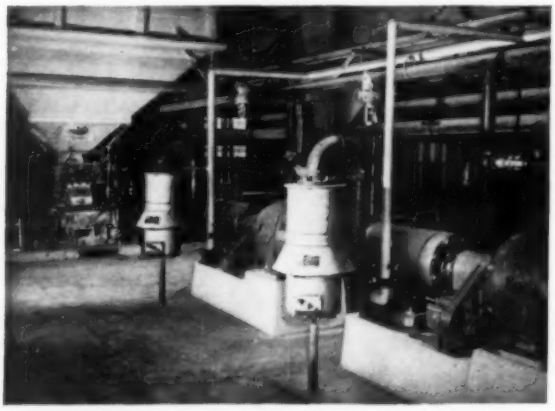
Visit Booth 513

Plant Maintenance and Engineering Show

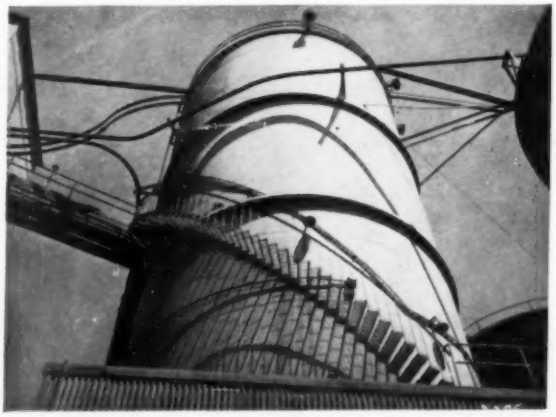
January 26–29 **Cleveland, Ohio**



F-H AIRSLIDE FLUIDIZING CONVEYORS ANGLE DOWNWARD from precipitator hoppers, move air-activated ash to 20-ton central surge hoppers under floor. There are few moving parts.



FULLER-KINYON PUMPS AND COMPRESSORS under surge hoppers propel ash to bins and silos at 20 tons an hour. Fluidized by air, the abrasive, 300°F. ash moves without injuring system.



BULK SILOS receive air-conveyed ash through Fuller-Kinyon pipe-lines. Farthest silo is 1,000 feet from pumps. Over 50% of fly ash is bagged and sold as a by-product.

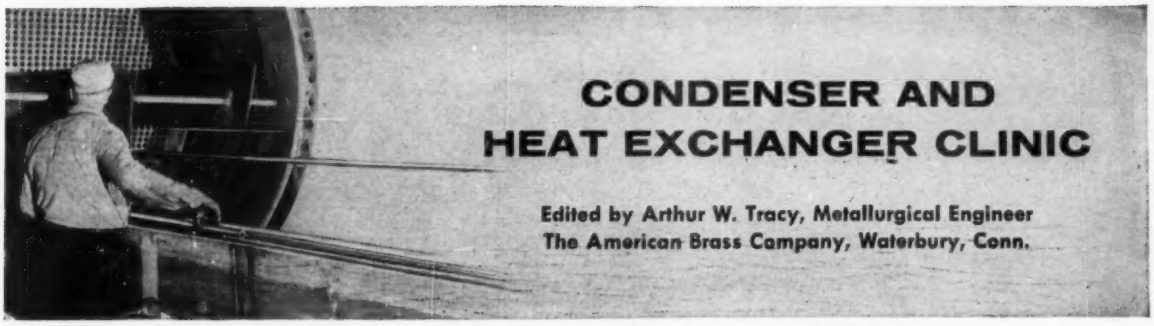
1235
G-203

Fuller
....pioneers in harnessing AIR

FULLER COMPANY
150 Bridge St., Catasauqua, Pa.
SUBSIDIARY OF GENERAL AMERICAN TRANSPORTATION CORPORATION
Birmingham • Chicago • Kansas City • Los Angeles • New York • San Francisco • Seattle

FULLER COMPANY GENERAL AMERICAN TRADE MARK

For more data circle 533 on Post Card



CONDENSER AND HEAT EXCHANGER CLINIC

Edited by Arthur W. Tracy, Metallurgical Engineer
The American Brass Company, Waterbury, Conn.

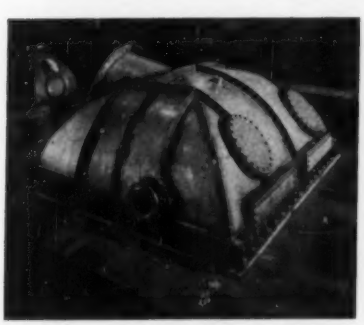
Cupro Nickel Alloys meet a wide range of severe corrosive and mechanical conditions

Cupro nickel alloy heat exchanger tubes serve satisfactorily when conditions require greater strength and corrosion resistance than are possessed by the brass alloys.

Developed To Meet Navy Requirements. Copper-nickel alloys were originally developed for use on U. S. Naval vessels to provide tubes which would give long and reliable service under extreme battle conditions. Research by The American Brass Company, begun in the last century, resulted in the manufacture of cupro nickel tubes for the Navy's fighting ships in the Spanish-American War and in World Wars I and II.

Navy experience with cupro nickel condenser tubes led to their use in express liners and other merchant craft, in central power stations, and then in industry for condensers, heat exchangers, and evaporators where their resistance to corrosion by a wide range of chemicals and their ability to maintain strength at elevated temperatures gave them an economic advantage.

Cover Wide Use Range. The American Brass Company produces condenser and heat exchanger tubes from Cupro Nickel, 30%-702 and Cupro Nickel, 10%-755, which satisfy most of the requirements for marine, power station and processing plant service. Cupro Nickel, 20%-712 is also produced, particularly for use under certain conditions, such as in feed-water heaters where operating temperatures and pressures are too high for brass alloys or the 10% Cupro Nickel, and not sufficiently severe to require the 30% alloy.



Water boxes for a naval steam condenser fabricated by welding ¼" sheet of Anaconda Cupro Nickel, 10%-755. The flanges and ribs are of steel. The Youngstown Welding and Engineering Company also fabricates pipe and fittings of Cupro Nickel, 10%, for salt-water service.

These alloys satisfy, economically, condenser and heat exchanger tube requirements that lie beyond the corrosion resistance and mechanical properties of copper and brass tubes.

Cupro Nickel, 30%-702 is the most widely used of the copper-nickel alloys. It is the most corrosion resistant and durable of the copper-base alloys for condenser and heat exchanger tubes in sea water service, being highly resistant to clean and polluted sea waters. It has the property of forming protective films of corrosion products, making it particularly desirable for service where water velocities are high. It is highly satisfactory for tubes in evaporators, inter-after condensers, air ejectors of steam condensers and in boiler feed-water heaters. This alloy is particularly desirable where high temperatures are encountered.

In high-pressure, high-temperature steam stations, Cupro Nickel, 30%-702 tubes are used in feed-water heaters regardless of the type of tube used in the main condensers. The high allowable design stress for this alloy qualifies it for this service.

Cupro Nickel, 30%-702 tubes are used in petroleum refinery heat exchangers when process liquids, vapors and cooling waters are particularly corrosive, and where its resistance to stress-corrosion cracking and good physical properties at elevated temperatures are required.

Cupro Nickel, 10%-755. This alloy was developed by The American Brass Company to conserve nickel and to provide a lower cost copper-nickel alloy to meet requirements not sufficiently severe to call for the higher nickel-content alloys.

Cupro Nickel, 10%-755 has proved an excellent alloy for salt water use. It is resistant to corrosion by both clean and polluted sea waters at relative high velocity of flow. It has given a good account of itself in stationary steam plants on tidewater, and in condensers and similar applications aboard ship.

Because of this excellent resistance to corrosion by sea water, Cupro Nickel, 10%-755 tubes are used in heat exchangers handling sulfur-free streams in a number of tidewater oil refineries.

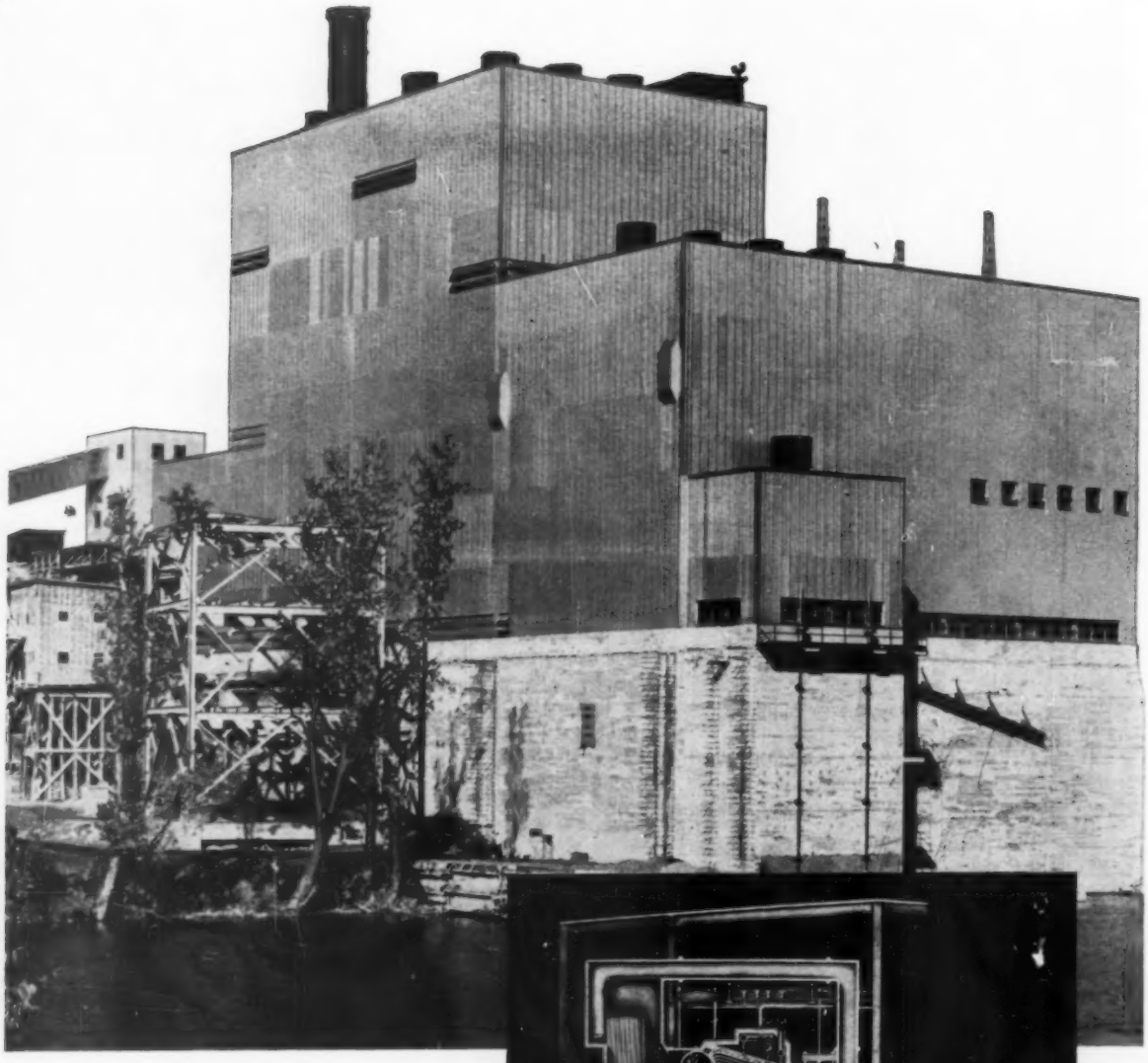
Cupro Nickel, 20%-712. This intermediate alloy serves adequately and economically where operating temperatures and pressures are too severe for Cupro Nickel, 10%-755 and where the properties of Cupro Nickel, 30%-702 would not be required, such as in boiler feed-water heaters.

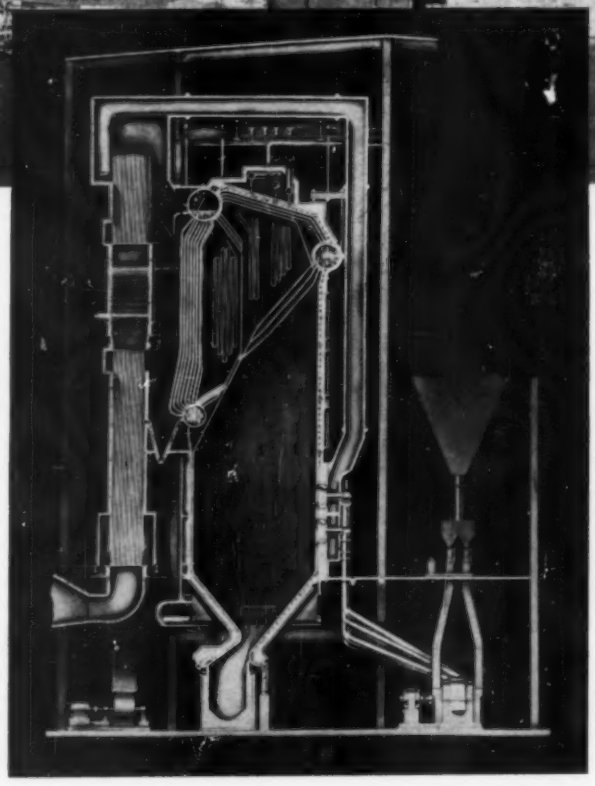
Technical Service. The Technical Department of The American Brass Company will be glad to study any heat-exchange problem you may have and help you select the tube alloy which will most adequately meet the conditions you face. Write: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

5980

ANACONDA®
Tubes and Plates for Condensers and Heat Exchangers Made by The American Brass Company

For more data circle 534 on Post Card





Riverton Station
Northern Virginia Power Company
Riverton, Virginia

Sanderson & Porter Engineers

A survey of your plant by a qualified consulting engineer could show ways of making surprising savings in your power costs.

A Dramatic Record Of Availability At Riverton Station

Riley Steam Generating Unit gives eight years of efficient service with but ONE forced outage

Engineers of Northern Virginia Power were so impressed with the availability factor of this Riley boiler that they voluntarily advised us that since November 1950 there has been but one short forced outage, making it the best boiler in the entire system from a service standpoint.

Here is a record of performance that is proof of dependability and one of the reasons why so many public utility companies have swung to Riley in the past ten years. This boiler operates at 875 psig and 900 F. and is fired by Riley pulverizers and burners.

Today, Riley designs incorporate outstanding characteristics which meet the exacting requirements of the modern power plant. We are confident that it will pay you to investigate modern Riley designs when you are considering the installation of additional steam generating equipment. Riley engineers will gladly call on you.

RILEY STOKER CORPORATION, WORCESTER, MASSACHUSETTS

RILEY

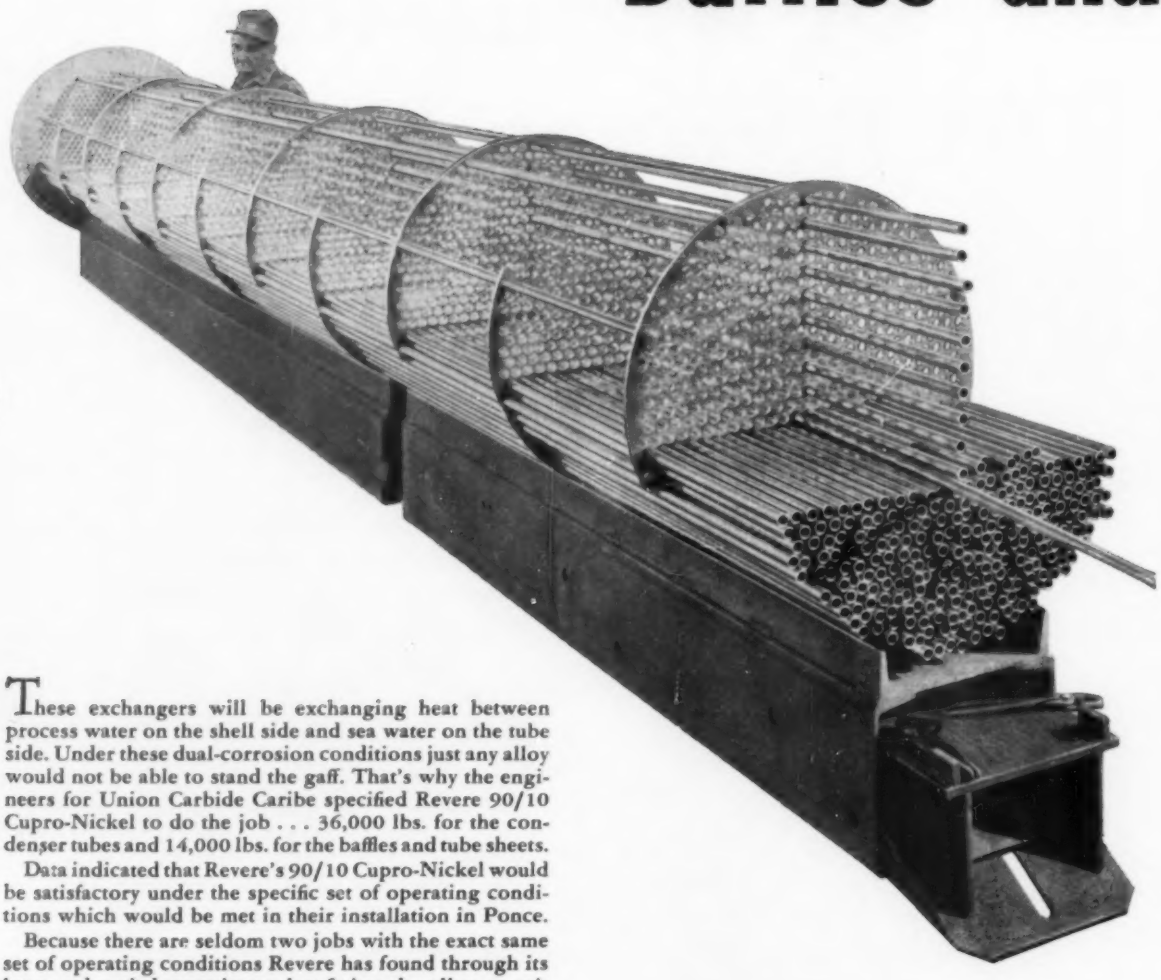
STEAM GENERATING & FUEL BURNING EQUIPMENT

Sales Offices

Charlotte, Chicago, Cincinnati, Cleveland, Detroit, Houston, Jacksonville, Kansas City, Los Angeles, New Orleans, New York, Philadelphia, Pittsburgh, Portland, Salt Lake City, San Francisco, Seattle, St. Louis, St. Paul, Syracuse, Worcester.

For more data circle 535 on Post Card

Revere 90/10 Cupro-Baffles and



These exchangers will be exchanging heat between process water on the shell side and sea water on the tube side. Under these dual-corrosion conditions just any alloy would not be able to stand the gaff. That's why the engineers for Union Carbide Caribe specified Revere 90/10 Cupro-Nickel to do the job . . . 36,000 lbs. for the condenser tubes and 14,000 lbs. for the baffles and tube sheets.

Data indicated that Revere's 90/10 Cupro-Nickel would be satisfactory under the specific set of operating conditions which would be met in their installation in Ponce.

Because there are seldom two jobs with the exact same set of operating conditions Revere has found through its long and varied experience that fitting the alloy to suit the job is the best way to extend tube life to the maximum.

To find the alloy or combination of alloys best suited to meet a specific set of operating conditions, Revere offers the help of its Research Department, made available through the Technical Advisory Service.

Revere makes tubes and tube sheets in all the customary as well as special alloys. See the nearest Sales Office.

ONE OF THE 4 heat exchanger bundles which collectively accounted for 50,000 lbs. of Revere 90/10 Cupro-Nickel in the form of tubes, baffles and sheets.

REVERE COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

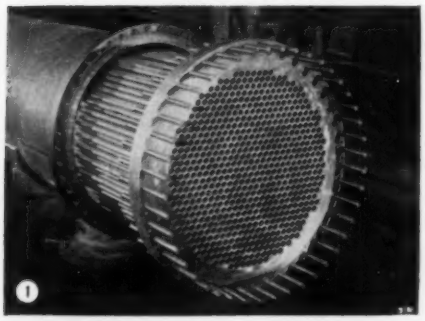
230 Park Avenue, New York 17, N. Y.

Mills: Rome, N.Y.; Baltimore, Md.; Chicago, Clinton and Joliet, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Brooklyn, N.Y.; Newport, Ark.; Ft. Calhoun, Neb. Sales Offices in Principal Cities, Distributors Everywhere.

Nickel Condenser Tubes, Tube Sheets

Fabricated into Heat Exchangers by ENGINEERS and FABRICATORS, INC.

to be used in the Union Carbide Caribe's chemical plant in Ponce, Puerto Rico under tough, dual-corrosion conditions

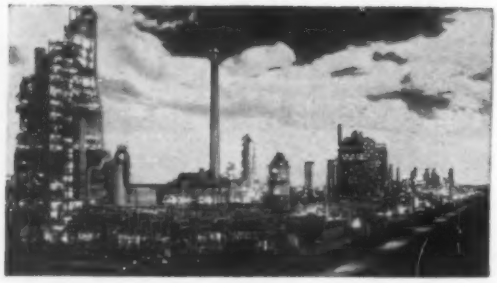


(1) CLOSE-UP of one of the bundles that has been completely tubed and is ready for bolting into the shell.

(2) COMPLETED UNITS with channel heads in place and completely stacked ready for shipment to the Union Carbide Caribe Incorporated chemical plant in Ponce, Puerto Rico.

(3) HERE YOU SEE a section of the shop of ENGINEERS and FABRICATORS, INC., Houston, Texas, where the 4 heat exchangers were made.

For more data circle 536 on Post Card



A plant built on the philosophy of "don't accept anything at face value"...

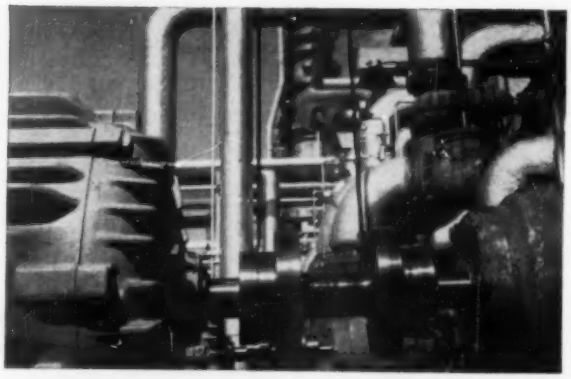
Tidewater's "Refinery of the Future" Uses 471 Fast's Couplings to Reduce Maintenance

IN PLANNING Tidewater's Delaware Refinery, all equipment purchases were examined from every angle . . . capital investment, manpower, maintenance and reliability. Fast's Self-Aligning Couplings were used throughout because they met Tidewater's exacting demands.

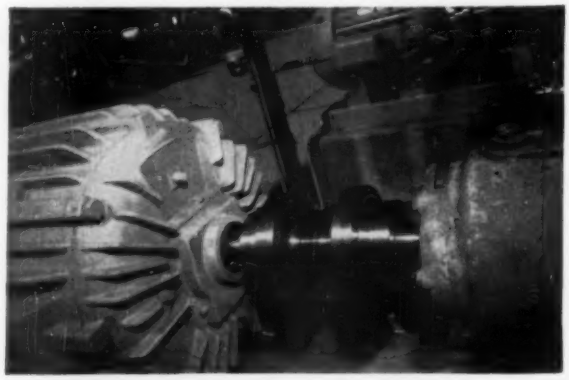
Tidewater's equipment design policies were established by survey teams that visited refineries all over the country. They carefully appraised each plant and asked operators what improvements they would make and what features they would retain if they were to redesign their drives.

In 471 applications at this refinery, Fast's Couplings guarantee mechanical flexibility that eliminates costly shutdowns and expensive shaft replacements. Fast's have the reputation of frequently outlasting the equipment they connect. This means savings in maintenance and down-time . . . in addition to protecting costly equipment against errors of alignment.

Nearly 40 years of coupling experience qualifies Koppers to solve *your* coupling problem. Write today for full details to: KOPPERS COMPANY, INC., Fast's Coupling Dept., 3712 Scott Street, Baltimore 3, Md.



Fast's Couplings give dependable, trouble-free service throughout Tidewater's entire production facilities.



This Fast's Coupling drives a pump delivering heavy naptha to the Solutizing plant.

Engineered Products
Sold with *Service*

KOPPERS

THE ORIGINAL
FAST'S Couplings

For more data, circle 537 on Post Card

MARTIN
ORLANDO

one of the top ten plants of the year

Architect-Engineer: Connell, Pierce, Garland & Friedman, Miami, Fla.; *General Contractor:* Thompson & Street Co., Charlotte, N. C.; *Steam Generating Equipment:* Power & Combustion, Inc., Baltimore, Md.; *Mechanical Contractor:* William H. Singleton Co., Arlington, Va.

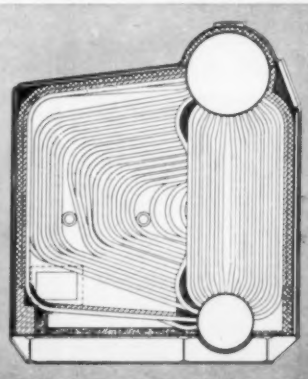
MARTIN-Orlando
dedicated to the service of America

A new type of facility — a complete research, development and production center for guided missiles, electronics and small weapon systems — Martin-Orlando is extremely functional and represents the most modern, scientific concepts of layout and design that man can devise.

selected KEELER dk package steam generators for their efficiency and compactness

Two Keeler DK's supply steam for the entire process, heat, hot water and air conditioning load of this ultra modern Martin plant. The entire facility, consisting of four main buildings with approximately 500,000 square feet of space, is located on a 6700-acre site near Orlando, Florida. The steam generators are supplying the steam requirements with capacity to spare and provision for future needs.

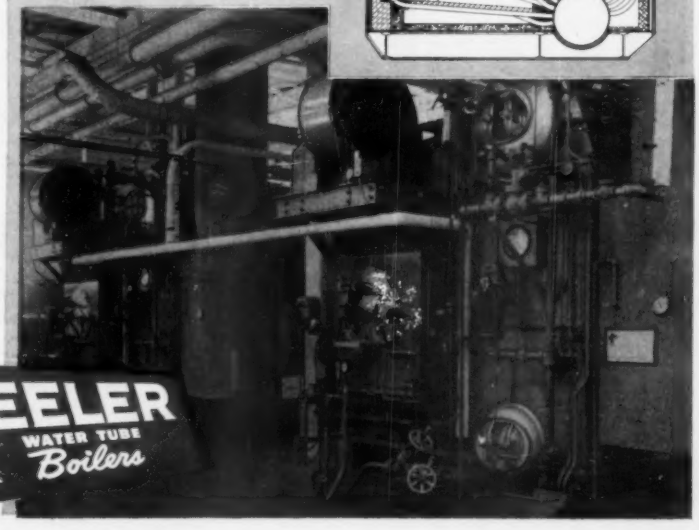
Each of the DK units has a 28,000 lb/hr capacity and is designed for 200 psi safe working pressure. Both are oil fired and operated at 125 psig — either unit capable of carrying the full load.



This is the third Martin installation of Keeler DK Package Steam Generators . . . Martin-Denver has two 465-hp units and Martin-Baltimore has a 450-hp unit.

Multi-purpose Keeler DK's are made in 24 sizes for gas, oil or combination firing, in capacities up to 60,000 lb/hr, standard design pressures to 600 psig. The unit is a completely steel encased package, with water cooled and insulated furnace sides, roof, floor, burner and target walls.

The DK features tube-to-tube construction on both sides of the furnace, providing the maximum amount of radiant heating surface. Uniform diameter water tubes facilitate cleaning or replacing — a truly low first cost, low operating cost package steam generator. *Write for full data and specifications.*



— ESTABLISHED 1864 —

The Seal of Quality in Water Tube Steam Generators

E. KEELER COMPANY
West & Church Sts.
Williamsport, Penna.

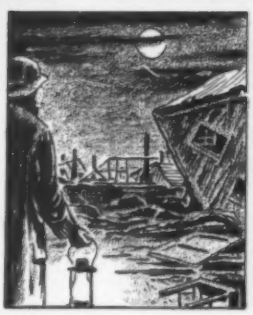
KEELER WATER TUBE Boilers

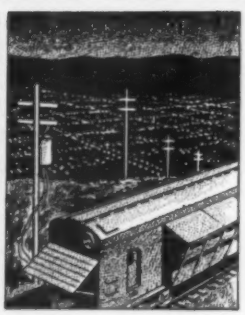
For more data circle 538 on Post Card

POWER POINTERS

Rocket hot or Cold as upper air

AT THE LOW TEMPERATURES OF HIGH ALTITUDES (BELOW-100°F.) ORDINARY STEELS ARE TOO BRITTLE TO USE. AT ROCKET ENGINE TEMPERATURES THEY'RE AS WEAK AS TAFFY. BUT HIGH NICKEL ALLOYS ARE DIFFERENT. INCONEL NICKEL-CHROMIUM ALLOY GETS EVEN STRONGER AND STAYS TOUGH AT SUB-ZERO TEMPERATURES. AND IF YOU TURN ON THE HEAT IT KEEPS USEFUL STRENGTH EVEN UP TO 2000°F.





"Blackout" to "lights on"

...in 12 hours mobile emergency unit delivers 12 times the power of first public utility

12 HOURS AFTER MOVING INTO A DISASTER AREA, THIS GAS TURBINE PLANT ON WHEELS DELIVERS 6,500 KW—OVER 12 TIMES THE POWER OF THOMAS EDISON'S ORIGINAL PEARL STREET STATION. TRANSITION SECTION OF UNIT'S GAS TURBINE, WHICH CHANNELS 1350°F GASES TO BLADES, IS INCONEL* NICKEL-CHROMIUM ALLOY. INCONEL ALLOY RESISTS CORROSION, OXIDATION, LOSS OF STRENGTH AT HIGH TEMPERATURES.

How the tube that couldn't be straightened started instrumentation

TRYING TO STRAIGHTEN A TUBE, INVENTOR BOURDON, CLOSED ONE END AND INJECTED HIGH PRESSURE STEAM. TUBE STRAIGHTENED ...BUT SNAPPED BACK WHEN STEAM WAS GONE! THUS WAS BORN THE BOURDON GAUGE...AND MODERN POWER INSTRUMENTATION. TODAY, MANUFACTURERS MAKE MANY HIGH PRESSURE BOURDON GAUGE TUBES OF "K"MONEL.* THIS NICKEL-COPPER ALLOY IS EASY TO FABRICATE, TAKES PRESSURES UP TO 100,000 PSI, HAS MINIMUM HYSTERESIS.

Having trouble with a metal problem?

TEAMING UP WITH INCO'S MECHANICAL ENGINEERING SECTION MAY HELP YOU COME UP WITH A PRACTICAL SOLUTION. AS A STARTER, WRITE **DEPARTMENT PE** FOR TECHNICAL BULLETIN "ENGINEERING PROPERTIES OF 'K' MONEL"

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street — New York 5, N. Y.

INCO

*Registered trademark

INCO NICKEL ALLOYS

For more data circle 539 on Post Card

Clyde Unloader operating at plant of a rural electric cooperative corporation in Kentucky.

Coal handling is simple as 1, 2, 3, with . . .

Three specialized Clyde units offer lowest cost coal handling

Self-propelled Clyde Whirley unloading from barges to stock piles and storage bins along river site.

Barge mounted Clyde hoist and derrick handling coal from barges to conveyor hopper for distribution to cars and trucks.

1 CLYDE UNLOADERS

Clyde Unloaders . . . the finest, most modern machines for high speed handling of bulk materials from barges or ships direct to distribution hopper in tower. Unloader can be equipped with self-propelling trucks or be stationary mounted. Three standard sizes with free digging capacities up to 1200 tons per hour.

2 CLYDE WHIRLEYS

Clyde Whirleys are specially designed for efficient, economical and fast cycle rehandling of materials. Their long reaching, full-revolving booms permit servicing exceptionally large areas. Materials can be unloaded from barge or ship to stock piles, storage bins or loaded directly into cars, trucks or hoppers.

3 CLYDE DERRICKS

Clyde Stiff Leg Derricks powered by Clyde hoists make an ideal combination for low cost, heavy duty material where degree of swing is limited. Anti-friction bearings on Clyde hoists and derricks reduce friction losses, save maintenance costs and permit heavier pay loads to be handled with less power consumption.

"Quality is Always Foremost in Clyde Products. Write for Detailed Bulletins on Any Item."

CLYDE RIC REPUBLIC INDUSTRIAL CORPORATION

CLYDE IRON WORKS, Inc.

Established 1899

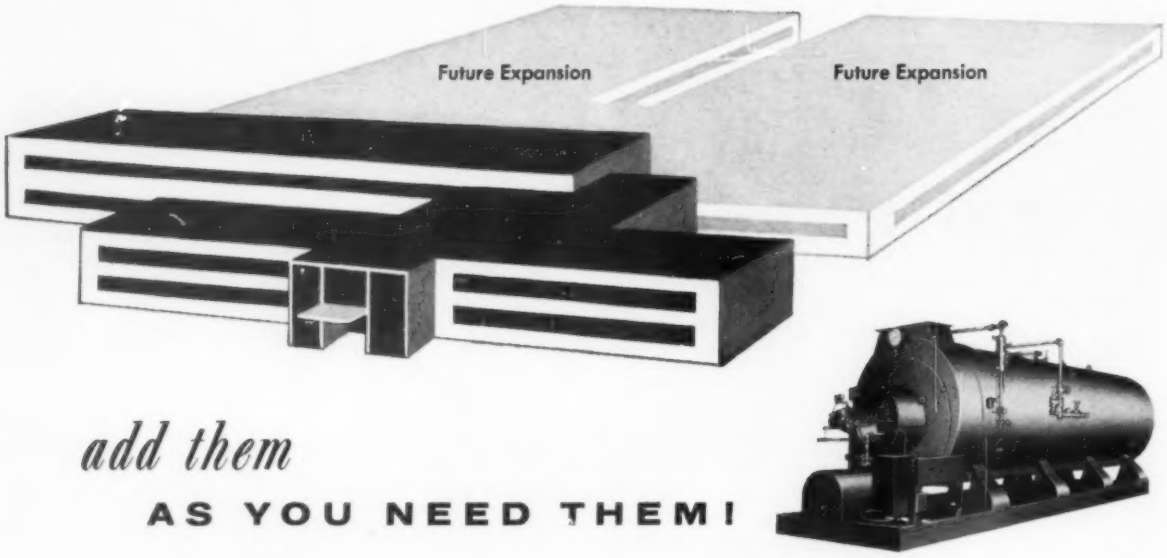
DULUTH 1, MINNESOTA

HOISTS : DERRICKS : WHIRLEYS : UNLOADERS
BUILDERS TOWERS : CAR PULLERS : ROLLERS

For more data circle 540 on Post Card

Plan for tomorrow

with CYCLOTHERM today!



add them

AS YOU NEED THEM!

With Cyclotherm Steam and Hot Water Generators you can plan your steam generating facilities to cover five — ten — fifteen years of plant expansion. Perhaps one 500 HP Cyclotherm will meet your present requirements. If you need 600 HP in 1958 — add a 100 HP Cyclotherm. If 200 more HP is needed in 1959, a 200 HP Cyclotherm will give you ample — *but not excess* — capacity. You buy as you grow — you pay only for what you use.

Only Cyclotherms lend themselves perfectly to a *progressive* increase in steam capacity. You can get them in 17 sizes — add units ranging from 18 to 750 HP. They're installed easily — need no stack, no excavation, no special foundation. A battery of Cyclotherms is easy to accommodate — a Cyclotherm takes up to 1/3 less space than even other package boilers. Completely factory assembled, too — set one down and with five simple connections it's ready to work.

Cyclotherm's Cyclonic Combustion guarantees plus 80% efficiency in only two passes. Larger units operate at from 30% to 100% of rated capacity without loss of efficiency — smaller units operate on and off automatically as load requires. Maintenance costs drop from 30% to 50%. And Cyclotherm's world-wide service-facilities are always at your disposal. For full information, write us today.

Swan Rubber Did It — So Can You!

Swan Rubber Co., of Bucyrus, Ohio, world's largest maker of garden hose, installed an 80 HP Cyclotherm in 1949. As Swan expanded, it installed:

1951	100 HP Cyclotherm
1953	100 HP Cyclotherm
1954	125 HP Cyclotherm
1955	125 HP Cyclotherm
1956	Two 500 HP Cyclotherms, one 125 HP Cyclotherm. (Built additional plant in 1956)

And Swan plans to install during 1957 another 500 HP, another 125 HP and a 30 HP Cyclotherm. In 1949, Swan planned for the future with Cyclotherm. You can plan for your future with Cyclotherm today.

YEARS AHEAD IN STEAM GENERATION

CYCLOTHERM®

STEAM AND HOT WATER GENERATORS

A Division of National-U.S. Radiator Corp., Oswego, N.Y.

Clip to Your Letterhead:

Cyclotherm Division
National-U.S. Radiator Corp.
50 E. First St., Oswego, N. Y.

Please send me your booklet *Cyclotherm Cyclonic Combustion*, also rotogravure copy of *Cyclotherm Sales Steam* with illustrations and descriptions of Cyclotherm installations.

For more data circle 541 on Post Card

DODGE PILLOW BLOCKS

Timken Bearing Equipped

America's super-quality line—with a 34-year record of keeping performance *up* and costs *down!* Five types—to fit practically any service condition. All assembled, adjusted, lubricated and *sealed* at the factory for precision performance—long life—dependability.

SPECIAL DUTY TYPE →

- Designed for extreme precision and high load capacities.
- Fully self-aligning.
- Special Duplex Timken Roller Bearing with tapered bore.
- Split tapered sleeve with straight cylindrical bore extends through entire length of housing.
- Easy to mount or demount. Adapter nut (or collar) clamps adapter sleeve to shaft with extreme firmness.
- Automotive type piston ring seals. Bearing is sealed both on and off the shaft.
- Rugged semisteel outer housing.
- Elongated bolt holes provide for lateral adjustment.
- Special dust cap protects lubrication fitting.
- Shaft sizes 1 7/16" to 8". Ask your local Dodge Distributor—or write us for Bulletin A670 giving complete technical data on America's most complete line of mounted bearings.

DODGE MANUFACTURING CORPORATION, 6400 Union St., Mishawaka, Ind.

CALL THE TRANSMISSIONEER, your local Dodge Distributor. Factory trained by Dodge, he can give you valuable help on new, cost-saving methods. Look in the *white* pages of your telephone directory for "Dodge Transmissioneer."

DODGE
of Mishawaka, Ind.

For more data circle 542 on Post Card

let's take a second look at air compressor costs

Let's look at what Joy compressors have to offer in saving you money where it counts the most. Let's assume that all compressors are competitively priced . . . and go on from there.

eagle-eye the installation first . . . here's where specifying Joy saves a bundle. Why? Because Joy stationary compressors are "Packaged" units. They're shipped complete, ready to run without tedious, costly site assembly. Joy compressors need as little as one-half as much foundation. You can save up to $1000 on that item alone.

plus savings in maintenance . . . *All the wearing parts:* the cylinder liners, cross head guides, valves, etc., are replaceable at your plant, by your men. This is a Joy exclusive. No specialists needed, no fancy tools required. Joy engineered these compressors to run for years on minimum maintenance.

and on operation, we'll let the people who have used Joy compressors for years do our telling for us. Nope—no modesty . . . but the money they've saved in operating costs annually would sound unbelievable coming from us.

If you're frowning over the choice of your next compressors and what to do to save a needed buck . . . . . .

Take a second look and get in touch with a Joy Engineer. He'll show you how Joy saves you money on air. Write Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa. In Canada: Joy Manufacturing Company (Canada) Limited, Galt, Ontario.

WSW 1 7165-243

WRITE FOR FREE BULLETIN 243-56C

JOY SAVES YOU MONEY ON AIR

COMPRESSORS • FANS • DUST COLLECTORS

For more data circle 543 on Post Card

The delicate ingredients in milady's cologne take more than garden-variety metering—as do the critical ingredients in chemical and food processing, gas odorizing and water treatment.

Accurate, dependable metering assures product quality and uniformity. Hills–McCanna metering and proportioning pumps assure precise metering at low cost. Do as the leaders in industry do—"look to the people who know and control flow."

WRITE TODAY *for a copy of our new booklet, "Precision Proportioning Pumps" which explains Hills-McCanna's complete line of pumps.*

HILLS-McCANNA COMPANY
4620 West Touhy Avenue • Chicago 46, Illinois

hills-mccanna company
THE PEOPLE WHO KNOW AND CONTROL FLOW

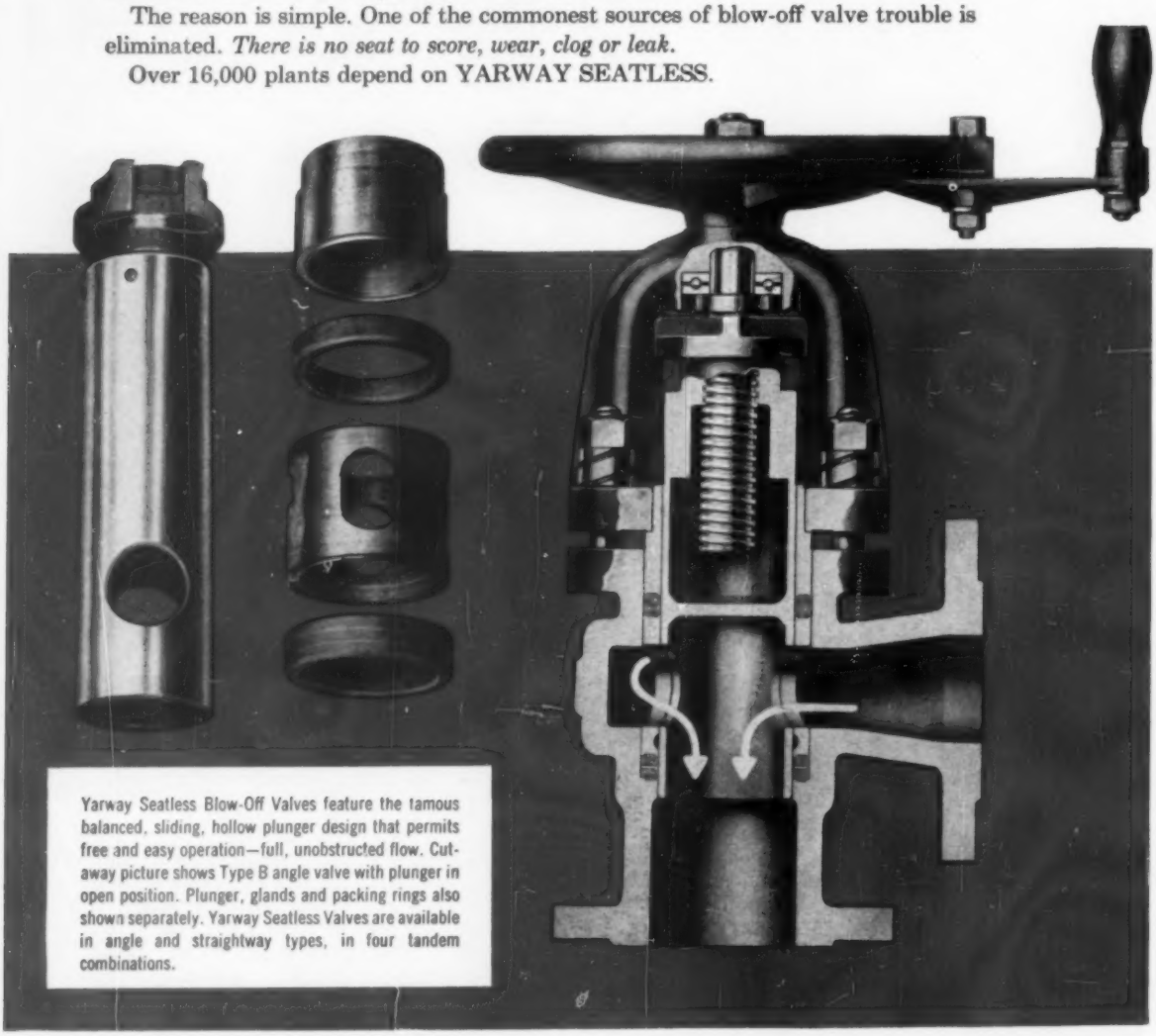
For more data circle 544 on Post Card

seatless means savings

For nearly 50 years boiler plants in low and medium pressure ranges have been saving maintenance time and down-time thanks to dependable, trouble-free blow-down service from Yarway Seatless Blow-Off Valves.

The reason is simple. One of the commonest sources of blow-off valve trouble is eliminated. *There is no seat to score, wear, clog or leak.*

Over 16,000 plants depend on YARWAY SEATLESS.



Yarway Seatless Blow-Off Valves feature the famous balanced, sliding, hollow plunger design that permits free and easy operation—full, unobstructed flow. Cut-away picture shows Type B angle valve with plunger in open position. Plunger, glands and packing rings also shown separately. Yarway Seatless Valves are available in angle and straightway types, in four tandem combinations.

For information on Yarway Seatless Valves, sizes, materials, pressures, etc., write

YARNALL-WARING COMPANY 100 Mermaid Ave., Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY SEATLESS ...a good way to specify blow-off valves

For more data circle 545 on Post Card

TRACERS

Power Engineering's Monthly Probe of Power Facts

Unique electronic-telemetering system for measuring the water content of mountain snowpacks has been perfected by U. S. Army Air Corps of Engineers and the Sierra Electronic Corp. It will go into operation this winter both in California's Sierra Nevadas and Idaho's Bitterroot range. Applicable also to stream gaging, the new equipment has significance for the planning and operating of hydroelectric plants.

New method for plating chromium directly to aluminum and its alloys is being offered by Service Hard-Chromium Co. It's called Chrom-Lume and eliminates the possibility of galvanic action and prevents undesirable electrolytic couples.

Mystery of the deterioration of refractory parts in the flame areas of oil-burning furnace units has been solved. Researchers have identified vanadium pentoxide as the culprit. This oil-soluble chemical compound occurs as an impurity in certain crude oils. Some of the Venezuelan crudes carry relatively substantial quantities of the compound, and their increased use recently is said to have precipitated the difficulty.

Iowa coal, for the first time, will be used as fuel for a cyclone furnace. This will be at Iowa Electric Light & Power's Sutherland Station at Marshalltown. Three 8-ft diam cyclones will fire a new B&W boiler being added to the plant. Tests indicate that this coal, which is low in heat value and high in moisture ash and sulfur, in the cyclone will result in over-all efficiency of higher than 88 per cent.

G-E has announced design of reheat turbines for units as small as 44,000 kw, with installations of this size currently in the works for El Paso Electric Co and Savannah Electric Co. Two reheat units of 50,000 kw are in process for Central Louisiana Electric Co. All are single-flow units. Current trend to double-flow units begins at and extends up from 50,000 kw, according to G-E.

Freon-TF solvent, from DuPont, is nonflammable, non-explosive and virtually nontoxic, may cut the cost of cleaning large electric motors maybe as much as 75 per cent, according to its developer. The solvent permits in-place cleaning, won't attack insulating materials and varnishes, DuPont reports.

Are transistor systems replacing magnetic amplifiers? A. G. Milnes of Carnegie Institute of Technology says that transistors are forging ahead, but that magnetic amplifiers will survive in many special forms. Turn to his analysis, page 88 this issue.

Among the six major nuclear reactor programs which Westinghouse has under way, two represent completely new concepts. First of these is a Fluidized bed solid fuel reactor which may use diesel oil as the moderator and coolant. Other is a thermoelectric nuclear reactor, using newly discovered materials to convert heat of fission directly into electricity. See ATOMICS, this issue, page 44.

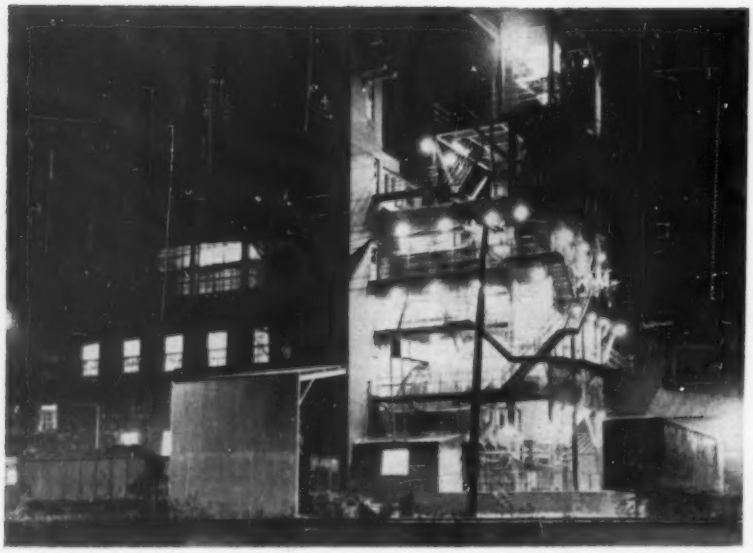


Fig. 1. Night view of 180,000 lb per hr outdoor boiler at Raisin River Paper Co

Inefficiency may be robbing your budget of more than the cost of a new power plant. This timely article tells how one authority analyzes the situation and designs a new power plant for greater efficiency and maximum return on investment to owner

Designing Small Industrial Power Plants For Maximum Net Earnings

FROM AN ECONOMIC point of view, many small industrial power plants are poor and many others not so good. For purposes of this discussion, industrial boilers of 40,000 to 200,000 lbs capacity per hour and turbines 1500 to 10,000 kw are considered comparatively small.

What Modernization Can Mean

With a poor power plant replaced, the net savings from a new, efficient plant may constitute all or a large part of the net earnings of a company. Many times a new plant also assures more production of goods by furnishing cheaper power and by-product steam at higher pressure.

As pointed out by Andrew A. Cummins before the 1958 American Power Conference, if a new power plant can be paid for out of savings in a reasonable length of time, **the cost of that plant is going to be spent in that time whether it is built or not.** The differences between installing and not installing a profitable new plant are:

1. If built, its cost will be spent sooner than if not built, but only a comparatively few years sooner.

2. If not built, the cost of the plant will be spent at the end of possibly seven, eight or ten years for unnecessary fuel, labor, purchased power and missed profits, and the owner will have only receipted bills to show for the money spent.

3. However, if built, at the end of seven to ten years it will:

A. At rates of equipment cost increase during the past ten years, be worth as much or more in dollars than when built.

B. Have 15 or more years of life remaining during which it can pile up larger savings.

The accompanying table shows a calculation based on a recent report which shows an investment of $800,000 with a nine year payout which would, based on a 25 year life, earn a net $1,784,040, or more than twice its cost. This is not taking into consideration probable increase in construction cost or increase in earnings. Quite often the payout time is seven to eight years. These earnings are after all interest, increased taxes, insurance and other expenses are taken care of.

Competent Engineering Saves

Different conditions exist at each plant; therefore each plant needs a careful engineering study to determine sizes, pressure, temperature, and the like for that particular plant based on its existing operation and what is planned for the future.

Plants where fuel and power can be saved will always need steam and electric energy; therefore accurately computed annual savings can be expected to continue for the life of the plant.

The reason many industrial power plants are poor is that they have been built without adequate study to insure best design and highest economy of operation, or they are obsolete. If it were fully realized how much money can be saved by competent engineering work included in a complete survey, analysis and design, there would be more top-notch industrial plants.

Data and Calculations

To develop such a plant, first thing the engineer must do is collect adequate data, carefully analyze it and arrive at optimum solutions. Data should include:

1. A description of the principal equipment requiring steam and power.

2. Amounts of product produced, such as paper, salt, etc, and the amounts of steam, power and fuel required by years, months and days with consideration being given to maximum, average and minimum needs.

3. Initial steam distribution to turbines, reducing valves, etc.

4. Steam and Btu distribution to the various processes at the various pressures needed, such as paper drying, water heating, salt evaporation, power generation, building heat, boiler room losses, etc.

5. Determination of recoverable losses in transmission and use.

6. Electric load and distribution.

7. Expected increase in steam and power requirements.

8. Indicator cards of engines in use for an estimate of power required, based on complete electrification.

Consider Future Expansion

Possible spread of operation should be considered. An installation cannot be made to work perfectly for all conditions, but limits can be set within which the operation will be highly satisfactory and through

which range the economy can quite accurately be predicted.

Reports should show pounds of steam required per hr, turbine size, pressure and temperature conditions for boiler and turbine to take care of existing load and projected operations for a considered time. The new power plant should be designed somewhat larger than existing conditions dictate to take care of future increases.

Opinions and ideas of the operating engineers should be welcomed since these are often of value. Final decisions on technical aspects, however, are the duty and function of the consulting engineer, because his broad experience and training qualify him to secure best results.

With this information and the owner's approval, the engineer can proceed with design. Factors to be considered will include size of boiler, pressure, temperature, heat recovery and firing equipment, dust collectors if it is a coal burning station, whether semi-outdoor or totally enclosed type construction will be used, and size and type of turbine.

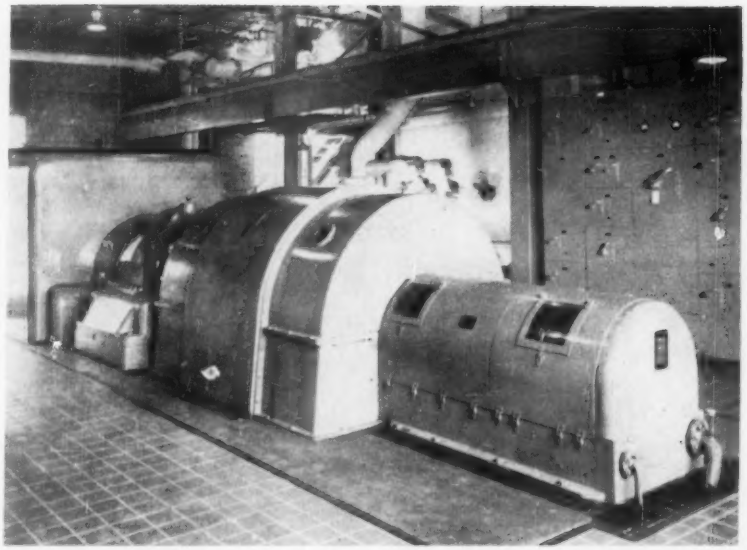


Fig. 2. Compact layout of Otsego Falls Paper Mills 4375-kw turbine generator

Semi-Outdoor Versus Enclosed

Semi-outdoor boilers have been installed frequently for the past 10 years in Michigan and Wisconsin. Figure 1 is a night view of a 180,000 lb-per-hr boiler at the Raisin River Paper Co plant at Monroe, Mich. which has been in operation for ten years. The firing aisle is enclosed in the old boiler house and two small lean-tos cover the side aisles so that the side furnace doors are sheltered. The advantages of the semi-outdoor boiler are less cost, easier cleaning and maintenance and reduced fire hazard. A $100,000 fire in the above plant put all old boilers in the building out of commission but left the outdoor boiler untouched.

An outdoor type induced draft fan installation was also installed. Fan bearings are air cooled and no difficulty has been experienced with this equipment due to the outdoor type installation.

The turbine generator should be sized large enough to carry existing loads plus expected increases covering a reasonable length of time. These might come from new plant equipment, from changing to electric drives for equipment now being driven by other means and from new power plant load.

Turbine Characteristics

Whether the turbine is to be straight non-condensing exhaust, non-condensing exhaust with extraction or condensing with extraction depends on the results of the study. If reasonably possible, the pressure and temperature should be chosen to produce all electric power requirements when operating non-condensing, and with the exhaust and extracted steam being used in process. This should be for the time of year when requirements for steam are least, usually in summer. Winter demands for steam can be met with a reducing valve.

Complete specifications are just as important for small plants as for large ones. Where these are not complete there will be a wide variation in quality, physical dimensions and real capacity of the equipment offered. Without complete information the owner is often hard put to resist an impulse to buy the equipment offered at the lowest price, with the result that often he does not get a satisfactory or desirable installation.

When a new plant is, within reason, designed on the basis of pressure and temperature high enough to give the minimum waste of Btu when generating all the electric power; when it furnishes new power and steam conditions which will assure increased output with existing production equipment; when the plant is made simple but efficient by taking advantage of semi-outdoor construction and compact arrangement to reduce investment and operating cost, then the owner will have a power plant designed to secure maximum net earnings. This, however, requires a study of all factors. THE END

Table showing the payout and earnings calculation for a hypothetical power plant with an initial investment of $800,000

PAYOUT AND EARNINGS CALCULATION

Estimated investment	$ 800,000	Deduct 52% federal income tax	$ 62,920
Estimated annual earnings before taxes, etc.	168,000	Net earnings	58,080
Deduct depreciation 5%; interest 5% on unpaid balance; increased property tax and insurance	67,000	Add depreciation	40,000
	101,000	Annual net earnings	98,080
Deduct 52% federal income tax	52,500	11 x $98,080 =	1,078,880
Net annual earnings	48,500	Net earned interest to 9 to 20 years	142,000
Add depreciation	40,000	Total net earnings in 20 years	1,220,880
Annual amount available for payoff	88,500	Earnings per year after depreciation $77,280	
$800,000 ÷ $88,500 = 9.0 years payoff		Earnings 20 to 25 years	
Annual earnings 9 to 20 years	168,000	5 x $77,280	386,400
Deduct 5% depreciation and increased property tax and insurance	47,000	Net earned interest 20 to 25 years	176,760
	$ 121,000	Total net earnings 25 years	1,784,040
		Original investment	800,000
		Total recovery in 25 years	$2,584,040

NEW IDEA: recirculating fly ash to the cyclone. It works well at Kodak Park

Fig. 1. Kodak Park's new cyclone-fired boiler is housed in this modern building

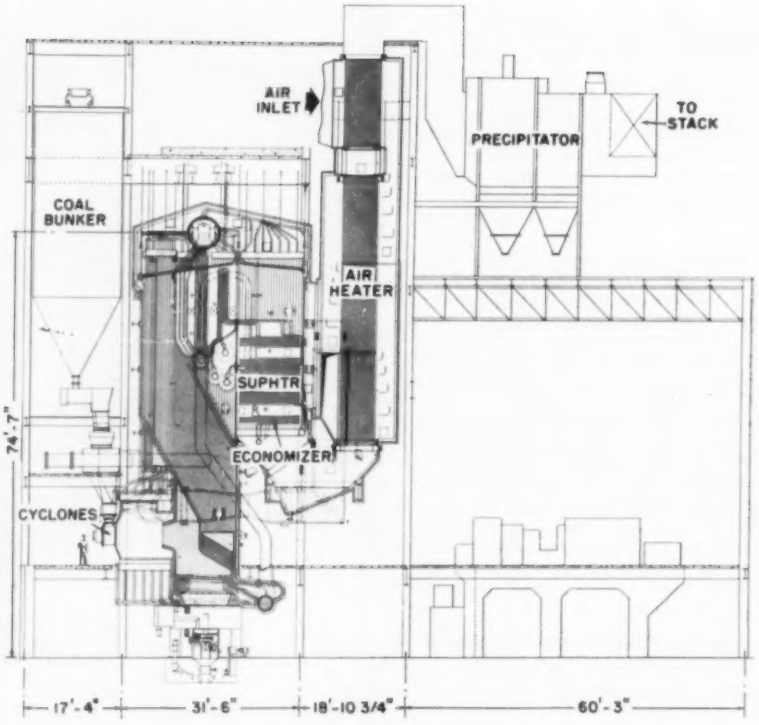


Fig. 2. Side view of boiler. Flue gases pass through a 90 per cent efficient precipitator. Dust is recirculated to cyclone, only 1.5 per cent of ash goes to stack

Cyclone Furnace With Dust Return

By RICHARD L. YOUNG *

WHEN EASTMAN KODAK engineers began planning features of an addition to a major-plant power facility, their study included extra consideration of cleanliness and plant-community relations.

Kodak Park, the company's largest manufacturing plant, lies in the center of a residential area in Rochester, N. Y. In the Park itself, the site for a new steam plant was surrounded by departments that manufacture photographic and chemical products under highest standards of cleanliness. The need for extreme care in handling fuel and disposing of waste products was paramount.

To meet the standards, an unusual precipitator dust-return system was designed for the installation of new cyclone-fired boilers, the first application of such a system to cyclone boilers on a non-experimental scale (Fig. 2). Construction was carried out largely by Kodak.

To a great extent, cleanliness considerations governed the choice of boiler. The cyclone furnace is cleaner in operation. It circulates only a small amount of fly ash through the boiler. It gives low stack dust loading. Most of the ash is removed in the primary furnace as a dense, easy-to-handle and dust-proof slag. And only about 15 per cent of the ash goes through the boiler passes.

Finally, the cyclone furnace provides a method for converting boiler-pass dust to slag by reinjection of the dust into the cyclone.

A design for coal having 8 per cent ash by weight, at rated capacity of 400,000 lb of steam per hour and 90 per cent collection efficiency, will lead to about 440 lb per hour of fly ash collected by the precipitator. This amount must be returned to the boiler through a conveyor system. Ultimate design calls for a design of 12 per cent ash, so that 650 lb per hour of fly ash will be collected by the precipitator and returned to the cyclones for refiring when boiler is operating at 400,000 lb of steam per hour.

If it becomes desirable at some future time to refire dust for other boilers, the reinjection system will handle up to 1800 lb of dust per hour. With the present hopper capacity, the furnace may be operated at 400,000 lb of steam per hour for a period of eight hours with the conveyor system out of service.

United Conveyor Nuvaflow system is used (Fig. 3) to recirculate the fly ash from the precipitator without an excessive dust or transportation problem.

Four hoppers under the precipitator receive the collected material. At the bottom of each hopper the fly ash passes through a slide gate and a feeder and enters a $2\frac{1}{2}$-in. trough (Fig. 3). The feeders provide an air seal to keep air from the troughs from venting back to the precipitator.

There are two troughs, each of which collects the dust from two hoppers. Air at approximately 35–55 in. of water and about 200 F is taken from the air side of the air heater and introduced into the ends of the $2\frac{1}{2}$-in. troughs to transport the dust. This hot air helps prevent corrosion of the conveyor casing. The troughs are rectangular in cross-section and have an horizontal porous diaphragm. Air enters the lower section of the trough and diffuses upward through

*Supervisor, Utilities Engineering Division, Kodak Park, Eastman Kodak Co, Rochester, N. Y.

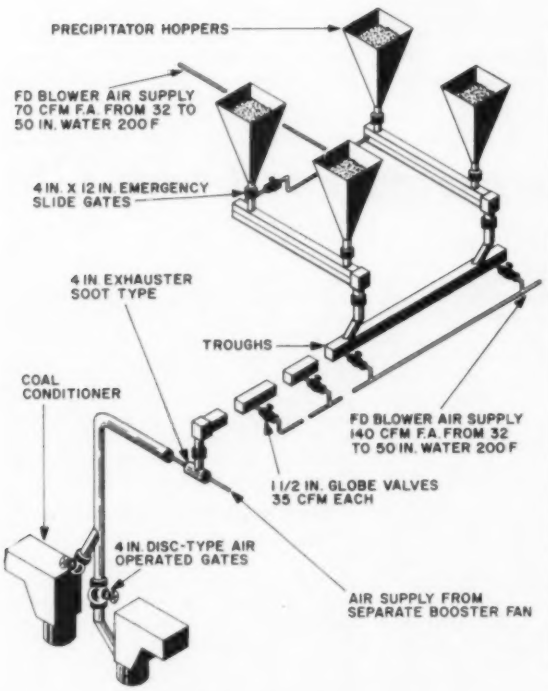

PRECIPITATOR HOPPERS
FD BLOWER AIR SUPPLY 70 CFM F.A. FROM 32 TO 50 IN. WATER 200 F
4 IN. X 12 IN. EMERGENCY SLIDE GATES
4 IN EXHAUSTER SOOT TYPE
TROUGHS
COAL CONDITIONER
FD BLOWER AIR SUPPLY 140 CFM F.A. FROM 32 TO 50 IN. WATER 200 F
1 1/2 IN. GLOBE VALVES 35 CFM EACH
4 IN. DISC-TYPE AIR OPERATED GATES
AIR SUPPLY FROM SEPARATE BOOSTER FAN

Fig. 3. Diagram shows how collected dust from precipitator is conveyed to connections located below the coal crushers

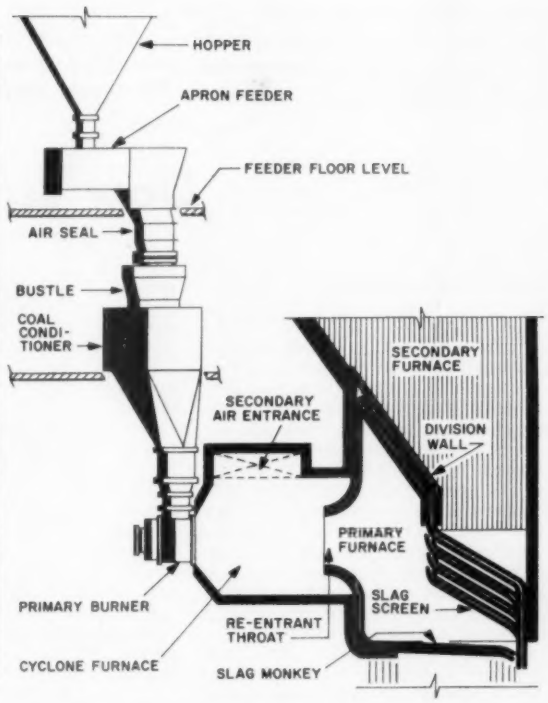


Fig. 4. Coal-feed system between bunker and cyclone. Dust mixes with the coal and primary air going to the cyclone

Keeps Kodak Park Extra Clean

the diaphragm. Dust enters the troughs in the upper section and is transported by air filtering through the porous diaphragm.

The two 2½-in. troughs enter 4-in. downcomers through feeder regulators and discharge into the main 4-in. trough which carries the dust toward the front of the boiler. Air is admitted to the conveyor at its end and at 20-ft intervals along its length. Valves regulate the air flow to the conveyor.

At the end of the 4-in. conveyor the dust enters a junction box which discharges into a vertical pipe. At the bottom of this vertical pipe air is introduced at 10 psig to bring the ash into the bustle below the coal crushers. This air is provided at 10 psig by a locally started and stopped Roots-Connersville motor-driven blower, through a 2½-in. pipe connection leading to the downcomer.

Jet action of the air entrains the dust and conveys it through an exhauster to a 4-in. pipe. This 4-in. line passes down between the apron feeders and air seals and then splits into two lines, one for each of the cyclone furnaces.

Lines to each cyclone are equipped with 4-in. disc-type air-operated gate valves, so that dust to each individual cyclone may be shut off. When the valves are shut, dust may accumulate above each valve which may not move when the valve is opened. Air purge connections are installed upstream of each gate valve to free any accumulation of dust. After the dust passes through the gate valve it enters the bustle below the cyclone coal crushers and mixes with the coal and primary air going to the cyclone (Fig. 4).

Vibrator-actuated splitter plate is installed in each hopper in addition to a Syntron vibrator. Any stoppage of fly-ash flow is eliminated by using either or both of these sources of vibration.

In operation today, boiler flue gases pass through a 90 per cent efficient electrostatic precipitator (Fig. 2). With dust recirculated from the precipitator to the cyclone, about 15 per cent of the ash finds its way as dust through the boiler to the precipitator and only 1.5 per cent passes to the stack. If the coal has 8 per cent ash, the flue dust to the stack at rated capacity is found to be approximately 0.08 lb per 1000 lb of flue gas referred to 150 per cent theoretical air.

Code requirement in Rochester is 0.85 lb per 1000 lb of flue gas. Without the dust collector and without recirculation, the dust to the stack is estimated to be 0.70 lb per 1000 lb of gas. Thus the plant would have been within code limits without the precipitator, but it was installed to secure the best possible community relations.

Operating experience has shown that there is no difficulty in melting the fly ash. Operators have learned to empty the precipitator hoppers before boiler shutdown, since moisture combines with fly ash to form a cement-like substance in the precipitator hoppers.

The recirculation of dust is a new development which has not been tried to any great extent on other installations. The purpose was not to recover the heating value in the fly ash, but to convert it to slag so that it could be stored, transported and disposed of without spreading dust and dirt. Kodak Park engineers feel that this design has satisfied system requirements. Extended operation will supply the final proof of adequacy. THE END

Is your lubrication program all that it should be? Wide range of equipment to be lubricated in the modern plant demands the best in lubricants, application devices and lubrication practices. Cost of the program is also a factor. This timely article tells how . . .

Dow Lubricates For Long Life

By D. H. SMALLRIDGE *

RANGE OF EQUIPMENT to be lubricated in the modern power generating plant covers a wide field; from fuel oil pumps or stoker and pulverizer drives to pneumatic tools for tube cleaning, etc., from the air compressors to drive the tools, to the cylinders of reciprocating equipment and the bearings of rotating machinery; from splash systems to intricate force feed lubricator fed systems; from the smallest oil cup to the largest turbine. Proper lubrication of this diversified array demands the best in lubricants, application devices and lubrication practices.

Midland Division of The Dow Chemical Company operates three powerhouses generating approximately 150,000 kw. Efficient operation demands a good preventive maintenance program. Scheduled application of the proper lubricants is one of its most important phases.

All lubricants are purchased and stored centrally. At present, nearly all are purchased on specification. This is made possible by a well-equipped laboratory in which the lubricants are evaluated. Field tests are also made to correlate laboratory results with the lubricants' performance on the job.

From base oil stocks thus purchased, the proper blends are formulated to meet the requirements of the equipment to be lubricated. The equipment manufacturers recommendations as to physical properties of the lubricant are followed except in those cases where it is felt that abnormal operating conditions dictate the use of a different lubricant.

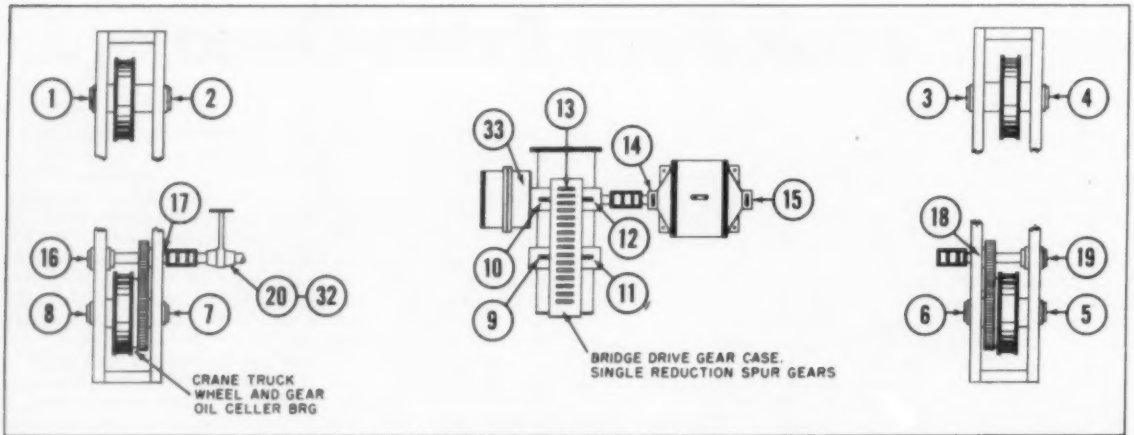
Sixteen lubricants do the entire job. This number was reduced over the years to simplify and economize on inventories, as well as to avoid confusion and possible application of the wrong lubricant.

Of these sixteen lubricants, only one is a grease. With this is performed all grease lubrication. An N.L.G.I. No. 1 consistency for ease of handling in tank-type loader guns, it contains a lithium 12-hydroxy stearate soap and an SAE-20 solvent-extracted coastal oil. Water-insoluble, it is used effectively over a temperature range of from below 0° F. to over 250° F.

Tank-type loader guns used

Grease handling has been improved through the use of the above-mentioned tank-type loader guns. These tanks are filled by gravity at a central location; each tank has a capacity of approximately thirty pounds. Grease guns are then filled through a fitting on the tank. The grease paddle is virtually eliminated and clean

* Supt. Lubrication Dept. Midland Div. Dow Chemical Co.



SHEPARD COAL CRANE - TRUCK WHEELS AND BRIDGE DRIVE

BEARINGS AND GEAR			LUBRICANT	INTERVAL	REMARKS
NO.	TYPE	FITTING			
1-8	BUSHING	OIL CUP	300T	MAINTAIN LEVEL DAILY	WOOL WASTE PACKED
9-12	BUSHING RING OILED	" "	"	" " "	
13	SPUR GEARS	OIL HOLE PLUG	COMPOUND ST CYL OIL	" " "	CHANGE ONCE A YEAR
14-15	SLEEVE	OIL WELL COVER	300T	" " "	RING OILED
16-32	BUSHINGS	OIL CUPS	"	" " "	" "
33	BRAKE	OIL HOLE PLUG	"	" " "	

Fig. 1. Sample diagram page from Dow Chemical's lubrication manual. Note detailed instructions for each critical area

grease is supplied to the bearing. Wasted grease due to handling is nil.

The majority of the oils used are blended within the plant to meet the requirements of the equipment to be lubricated.

An SAE-20 straight mineral oil is used for all hand oiling and whenever a medium machine oil is called for. It is a solvent-extracted mid-continent neutral stock. Its high viscosity index of 95 and its good pour point of 0° F. make it well suited for general purpose oiling.

Three blends cover wide range

Three blends of oils are used for all speed reducer lubrication utilizing spur, bevel, helical or herringbone gearing. Those reducers with worm or hypoid gears are lubricated with a blend which may be either an SAE-40 or SAE-70 in viscosity, to which has been added an extreme pressure additive. This may be a sulfur, chlorine or phosphorus compound. Care must be taken, particularly with sulfur, that it is not free sulfur, as corrosion will result.

Steam cylinder lubrication calls for a heavy-bodied oil which will emulsify readily with any condensed steam in the cylinder; forming a tenacious emulsion which will not wash off the cylinder wall. Such an oil is a blend of steam-refined cylinder stock and a small amount of acidless tallow oil. This blend is also suitable for use in worm or hypoid geared speed reducers due to the additional load-carrying properties imparted by the tallow oil.

For use in internal combustion engines and other applications demanding this type of oil, the desired viscosity grade mineral oil is fortified by adding a dispersant and an oxidation and corrosion inhibitor. This type of oil is also used in rotary compressor lubrication.

Gear shields are used on open gears where bath lubrication is not practicable. These materials are asphaltic compounds, tacky to resist being thrown off by centrifugal force, and do a fair job of lubrication. Two consistencies are used to cover applications in temperature extremes.

Turbine grade oils are used in ring-oiled bearings on pumps, motors and other rotating equipment, as well as in turbines. These oils are purchased; two more are blended. The purchased oils are of different viscosity grades to cover two types of turbine circulating systems; those in which the oil is also pumped to the reduction gearing and those without.

The turbine oils blended here are an SAE-10 and SAE-20 in viscosity, to which have been added di-tertiary-butyl-para-cresol for oxidation inhibition, a di-methyl polysiloxane for foam depression and a fatty acid material for rust prevention and improved lubricity. Centrifugal purifiers help to extend oil life almost indefinitely. Turbine oils are sampled at regular intervals and tested according to ASTM method D943–54. This method of test is intended for the determination of oxidation inhibitor life of inhibited turbine oils, including those used for turbine reduction gears.

Training is Important

Application is handled by a crew of oilers. These men are thoroughly trained and instructed in the proper methods and intervals for lubrication, as well as the proper lubricants for each piece of equipment. Manuals have been written showing in detail each individual piece of equipment with its lubrication points, the correct lubricant, and frequency with which it is to be lubricated.

Manual's introduction is shown in Fig. 1 along with a page showing the manner in which the lubrication instructions are written and illustrated.

A valuable by-product of Dow's lubrication program is the regular inspection of each piece of equipment by the oiler. Though a speed reducer is drained, flushed, and refilled only once a year, it is inspected weekly for proper oil level and oil condition. He also notes any unusual temperatures, noises or vibrations. These are reported at once to supervision, and corrections made while the trouble is still minor. Many equipment failures have thus been averted, and the program has paid for itself manyfold. THE END

BEARING LUBRICANT

Use the RIGHT KIND of lubricant

Keep it clean

Don't use too much

This manual contains a lubrication chart for every piece of equipment that you will lubricate. It specifies the kind of grease to be used, how often and how much.

Follow instructions. Use only grease where grease is specified, and oil where oil is specified. Be sure to use exactly the *kind* of lubricant the manual calls for.

The life of any bearing or gear depends upon the care it is given. It is not only important that the proper grade of lubricants are used, but also these lubricants must be kept free from dirt, moisture, graphite and other foreign matter.

General Instructions for Good Lubrication!

1. Store grease in clean containers. Handle grease with clean paddles or grease guns. When removing cover, do not lay where it can pick up dirt. Keep grease containers well covered.

2. Before greasing, wipe clean the pressure gun and the region around the fitting and relief plug. Remove the relief plug, if available, and free the relief hole of any hardened grease.

3. Never add grease with a pressure gun without first removing the relief plug. Don't over-fill. Grease or oil will ooze out of over-filled housings past seals and closures, collect dirt and cause trouble. It should be understood that anti-friction bearings require comparatively small amounts of grease. Housings should be filled from ¼ to ½ full. The immediate effect of an excess of grease within a bearing is over-heating due to churning of the lubricant. Under such conditions the grease tends to disintegrate and gradually loses its value as a lubricating medium. Always remember that injury to anti-friction bearings is more likely to result from over-greasing than from under-greasing. Inspect seals and wipe up excess grease.

4. Before adding any oil to a bearing housing or gear box, notice the level and appearance of the oil in the level gauge. If it looks dirty, it may be time for a change. Remember that oil requires frequent replenishment at high temperatures. Oil is always subject to deterioration from use and contamination from dirt and moisture. In time, accumulated sludge can be harmful to bearings and gears, causing premature wear. For this reason, draining and flushing are necessary at regular intervals. With ball bearings the oil level should never be more than 1/16" to 1/8" above inside diameter of the outer race at lowest point of bearing. When the level is too high the oil splashes, foams and seeps out along the shaft, wasting oil and possibly deteriorating motor windings. A too-high level causes churning of the oil which often results in overheating. Pressure also builds up which, combined with excessive heat, will in time ruin the oil seals and also cause leakage along the shaft. To prevent this build-up of pressure, a breather or vent plug is utilized. Its purpose is to equalize pressure within the housing with outside or atmospheric pressure. Be sure it functions properly.

5. If hand-oiling is used, be sure to oil at frequent and regular intervals. Cups and reservoirs of bottle, wick or siphon oilers and mechanical systems should be filled often enough to prevent their becoming empty. Clean the lubricators from time to time and do not let them become filled with dirt or foreign matter. Above all, do not let them run dry.

6. In splash systems, it is good practice to drain off any water or sludge that may accumulate in the sump. Also check oil rings so that they are round and turn freely.

Fig. 2. Introductory page of Dow's lubrication handbook. Diagrams for each piece of equipment leave nothing to chance

How Much Increase in Line Capacity With Power Factor Correction?

By ROBERT S. HORN*

The author feels that in many cases the use of capacitance to correct power factor and thus increase the kw load-carrying capacity of a given line is not being exploited as far as it is practicable

WHEN THE RECEIVING-END kw-load capacity of a line is limited by the permissible line voltage drop, just how far does it pay to correct the power factor of the receiving-end load for the purpose of increasing the receiving-end kw-load capacity?

Some say it is not economical to correct beyond 90 per cent, while others will stretch a point and go as far as 95 per cent. Some may claim that it takes so much more capacitance for a given amount of gain obtained by correcting the power factor to a value above 95 per cent that it is too costly to correct beyond that value.

Truth of the matter is, a correction from 95 to 100 per cent offers approximately the same kw gain in line capacity per (kva) unit of capacity of a power-factor-correcting capacitor as that obtained with a correction from 80 to 85 per cent.

Transformers

Erroneous opinions concerning the benefits of power-factor correction for lines apparently stem from what appear to be relatively well-known facts pertaining to the use of power-factor correction for the purpose of increasing the kw capacity of generators and transformers. For this reason, it is perhaps worth while to review an example concerning a transformer before studying the subject as applied to lines.

Figure 1 is given for this purpose. As may be seen, correcting the power factor of the secondary load on this transformer from 80 to 100 per cent increases its kw capacity in exactly the same proportion when the load on the transformer is maintained at its rated value of 1000 kva. An increase from 800 to 1000 kw constitutes an increase of 25 per cent. Starting with a power factor of 80 per cent, this is the most we can increase the kw capacity by power-factor correction.

If the load power factor is modified beyond a value of 100 per cent, that is, into the leading power-factor zone, it will actually reduce the kw capacity of the transformer to a value that is less than that which it has when it is operating at a power factor of 100 per cent. Incidentally, this is not the case with any conventional overhead line or with a circuit that consists of a conventional overhead line combined with a receiving-end and/or sending-end transformer when the circuit kw capacity at any given power factor is limited by the maximum permissible circuit voltage drop.

Figure 1 also shows the amount of capacitance that is required to change the power factor of the load on the transformer from 80 per cent lagging to any value between 80 per cent lagging and 96 per cent leading, when the load on the transformer is maintained at 1000 kva.

An inspection of this curve shows that it requires about 110 kva of capacitance to increase the load capacity of the transformer from 800 to 850 kw, and about 350 kva of capacitance to increase its capacity from 950 to 1000 kw. In the latter case it requires over three times as much capacitance for a correction of 5 per cent as it does in the former case. In practically all instances the relatively large investment in capacitance that would be required to correct from 95 to 100 per cent cannot be justified.

* Consulting Engineer. Copyright 1958. Republication rights reserved

Editor's Note: This is another article by the author of the Lucas Graphs, which were first presented to the public in the September issue of POWER ENGINEERING. Hundreds of requests for the full set of Lucas Graphs testify to the reception which they received, and the importance which they were accorded. Now Mr. Horn presents here his very interesting opinions on a subject currently receiving a great deal of attention, the use of capacitance to improve power factor, and thus increase the load-carrying ability of a line.

(To those who still wish the Lucas Graphs, single copies of the full set are available free. Jot Lucas Graphs on the bottom of the inquiry card elsewhere in this issue.)

Mr. Horn has now returned from Nagoya, Japan, where he was a consulting engineer for a number of years, and is now practicing in this country.

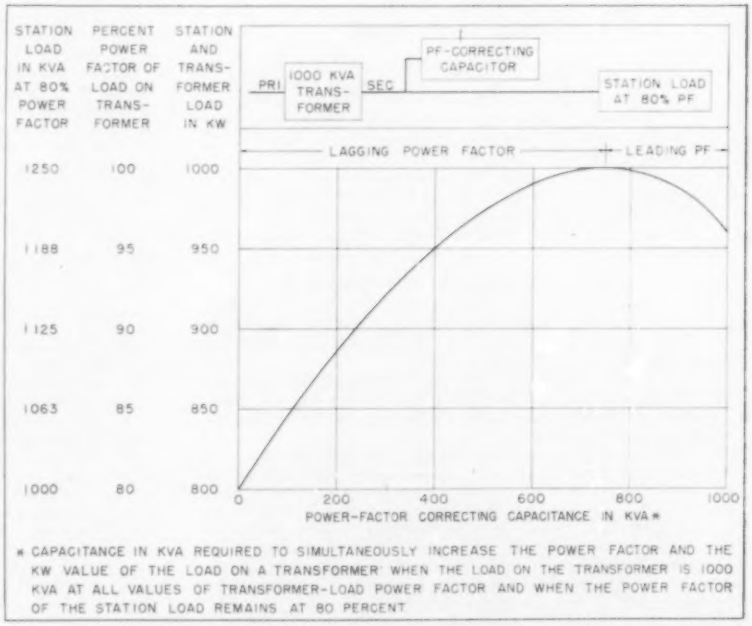

STATION LOAD IN KVA AT 80% POWER FACTOR
PERCENT POWER FACTOR OF LOAD ON TRANS-FORMER
STATION AND TRANS-FORMER LOAD IN KW
PRI
1000 KVA TRANS-FORMER
SEC
PF-CORRECTING CAPACITOR
STATION LOAD AT 80% PF
LAGGING POWER FACTOR
LEADING PF
1250 100 1000
1188 95 950
1125 90 900
1063 85 850
1000 80 800
0 200 400 600 800 1000
POWER-FACTOR CORRECTING CAPACITANCE IN KVA*
* CAPACITANCE IN KVA REQUIRED TO SIMULTANEOUSLY INCREASE THE POWER FACTOR AND THE KW VALUE OF THE LOAD ON A TRANSFORMER WHEN THE LOAD ON THE TRANSFORMER IS 1000 KVA AT ALL VALUES OF TRANSFORMER-LOAD POWER FACTOR AND WHEN THE POWER FACTOR OF THE STATION LOAD REMAINS AT 80 PERCENT

Figure 1. Improvement of load-carrying capacity of a transformer operating at its rated kva as additional power-factor correcting capacitance is installed

At a given load power factor the kw capacity of all transformers and some very short lines is limited by the current-carrying capacity of their conductors. However, the kw capacity of most lines at a given load power factor is limited by the maximum allowable line voltage drop, and it is only these lines to which this article pertains.

Receiving-End Correction

Now we shall see how the kw capacity of a line varies as we increase the receiving-end load power factor from 80 to 100 per cent. The term "line kw capacity" as it is used here refers to the load in kilowatts that a line can transmit with a given sending-end voltage, a given percent line voltage drop, and a given receiving-end load power factor.

Figure 2 is given for this purpose, and also shows the relative amount of capacitance required to bring about various degrees of power-factor correction. We have now arrived at the significant point in this article: **The slope of each one of the curves shown changes only a small amount throughout its entire length.**

With reference to any given one of the lines to which Fig. 2 pertains, this means that when the power factor of the load on the station is fixed at 80 per cent, the increase in the receiving-end kw-load capacity per kva of capacitance used to correct the power factor of the load on the line is approximately the same at any power factor within the range of 80 to 100 per cent.

The curve for the size 4/0 line shows that if the power factor of the receiving-end load were increased from 80 to 95 per cent the kw capacity of this line would be increased 47 per cent; and if the power factor were increased from 80 to 100 per cent its kw capacity would be increased 122 per cent. The additional correction of 5 per cent, namely from 95 to 100 per cent, increases the kw capacity of this line by an amount that is equal to 75 per cent of that capacity which it has when the power factor of the receiving-end load on the line is 80 per cent!

An inspection of the curve for a No. 4/0 line also shows that if the power factor of the load on this line were corrected from 95 to 100 per cent, the kw capacity of this line would be increased from a value of 147 to 222, as indicated by the per cent kw scale. This corresponds to an increase of 51 per cent of that capacity which it has when the power factor of the receiving-end load on the line is 95 per cent.

Power Factor of Load

If the power factor of the load on the station were 95 per cent instead of 80 per cent as shown, this increase of 51 per cent could be accomplished with less capacitance added to the circuit per kw gain in line capacity than that required when the power factor of the load on the station is 80 per cent.

This is because it requires less capacitance to correct the line-load power factor from 95 to 100 per cent when the power factor of the station load is 95 per cent than it does to correct the line-load power factor from 95 to 100 per cent when the power factor of the station load is only 80 per cent. In the case of this particular 4/0 line it requires only about ⅔ as much capacitance.

Consequently, when additional line kw capacity is required and the power factor of the station load has a high value, such as 95 per cent, there is more justification than ever for increasing the power factor of the receiving-end load on the line to 100 per cent.

A comparison of the curves in Fig. 2 clearly indicates that the effect that power-factor correction has on increasing the kw capacity of a line is a function of the ratio of the series resistance to the series inductive reactance of the line conductors. When the line R to X ratio is relatively low, the increase in the kw capacity is relatively high and vice versa.

Each curve in Fig. 2 covers a power-factor range of 80 to 100 per cent and would continue smoothly into the leading power-factor zone had a portion of this zone been included. This means that additional circuit capacity can be obtained by modifying the load power factor beyond 100 per cent. In some cases this is quite economical; however, modification into the leading zone is beyond the scope of this article.

Lucas Chart

The Lucas Chart (Fig. 3) is for the purpose of enabling one to very quickly determine the amount that the receiving-end kw load capacity of a line may be increased by increasing its receiving-end power factor; and just how much capacitance in kva is required to bring about such an increase in load capacity.

Knowing the amount of capacitance required, one can estimate the cost of making such an addition to a circuit. This estimate can then be compared with the cost of adding another circuit to a line or reinsulating an existing circuit for operation at a higher voltage, and adding or exchanging terminal equipment as required.

It can be shown that in many instances a power-factor correction from 95 to 100 per cent would eliminate the need of employing some other way of obtaining additional transmission capacity that would be much more costly.

Curves on the Lucas Chart are based on the voltage drop in a circuit being equal to 10 per cent of the receiving-end voltage. As may be seen, however, the chart may be used to obtain a close approximation of the numerical values that pertain to many circuits that have a voltage

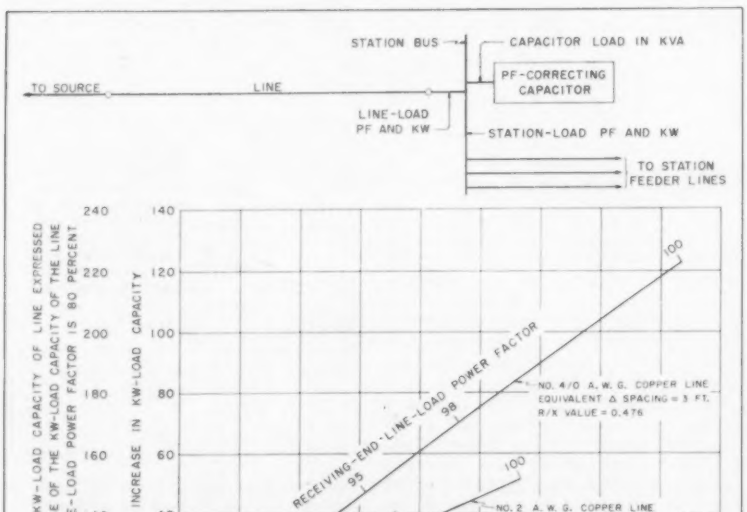
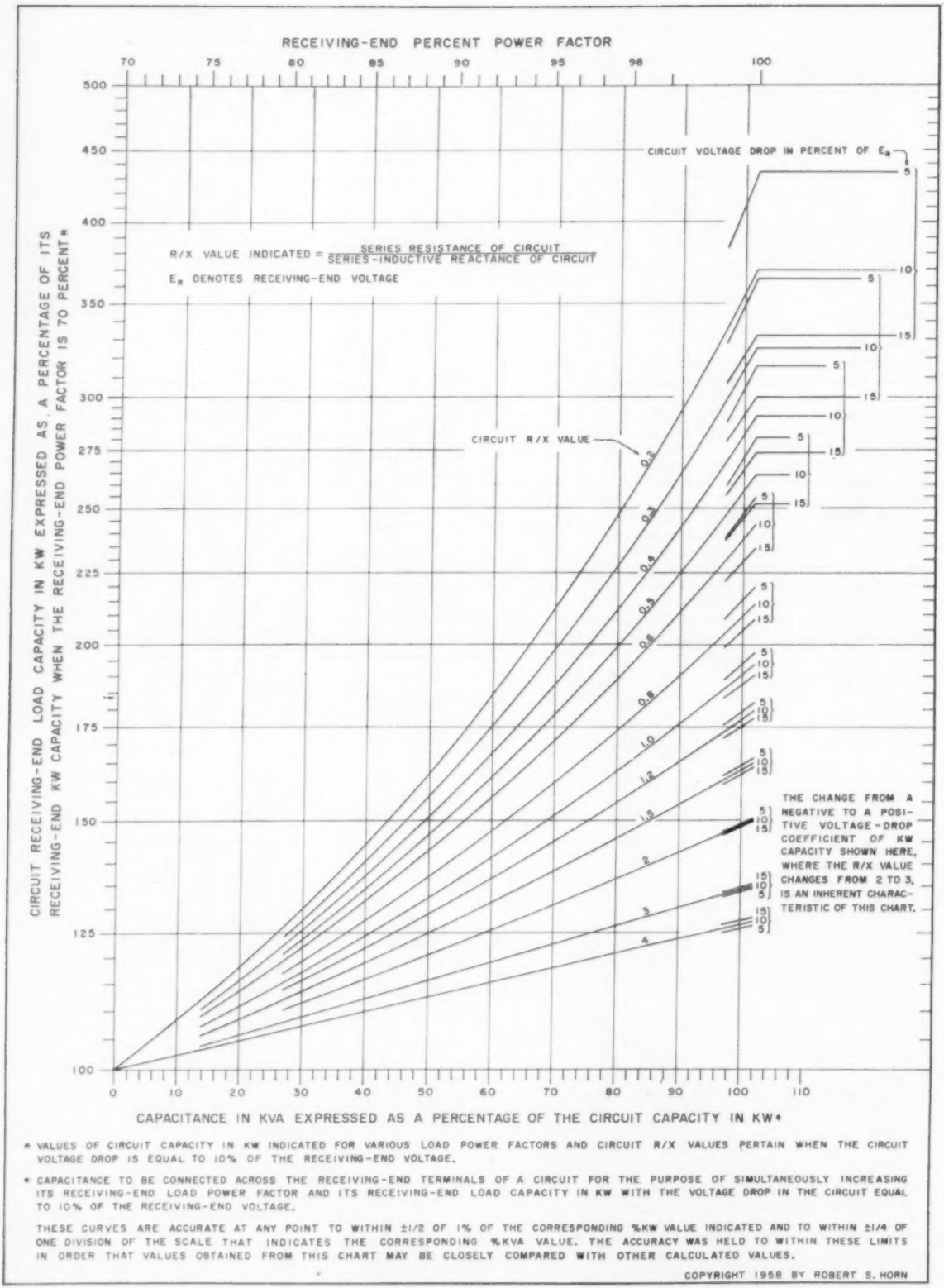

STATION BUS
CAPACITOR LOAD IN KVA
PF-CORRECTING CAPACITOR
TO SOURCE
LINE
LINE-LOAD PF AND KW
STATION-LOAD PF AND KW
TO STATION FEEDER LINES
RECEIVING-END KW-LOAD CAPACITY OF LINE EXPRESSED AS A PERCENTAGE OF THE KW-LOAD CAPACITY OF THE LINE WHEN THE LINE-LOAD POWER FACTOR IS 80 PERCENT
PERCENT INCREASE IN KW-LOAD CAPACITY
RECEIVING-END-LINE-LOAD POWER FACTOR
NO. 4/0 A.W.G. COPPER LINE EQUIVALENT Δ SPACING = 3 FT. R/X VALUE = 0.476
NO. 2 A.W.G. COPPER LINE EQUIVALENT Δ SPACING = 3 FT. R/X VALUE = 1.36
NO. 6 A.W.G. COPPER LINE EQUIVALENT Δ SPACING = 1.5 FT. R/X VALUE = 3.48
CAPACITANCE IN KVA EXPRESSED AS A PERCENTAGE OF THE LINE-LOAD CAPACITY IN KW WHEN THE LINE-LOAD POWER FACTOR IS 80 PERCENT*
* CAPACITANCE REQUIRED TO SIMULTANEOUSLY INCREASE THE LINE RECEIVING-END POWER FACTOR AND KW-LOAD CAPACITY WHEN THE LINE VOLTAGE DROP IS EQUAL TO 10 PERCENT OF THE RECEIVING-END VOLTAGE AND THE POWER FACTOR OF THE STATION LOAD REMAINS AT 80 PERCENT.

Figure 2. Showing the almost-linear relationship of additional capacitance in kva to receiving-end kw-load carrying capacity as the power factor is improved



* VALUES OF CIRCUIT CAPACITY IN KW INDICATED FOR VARIOUS LOAD POWER FACTORS AND CIRCUIT R/X VALUES PERTAIN WHEN THE CIRCUIT VOLTAGE DROP IS EQUAL TO 10% OF THE RECEIVING-END VOLTAGE.

\+ CAPACITANCE TO BE CONNECTED ACROSS THE RECEIVING-END TERMINALS OF A CIRCUIT FOR THE PURPOSE OF SIMULTANEOUSLY INCREASING ITS RECEIVING-END LOAD POWER FACTOR AND ITS RECEIVING-END LOAD CAPACITY IN KW WITH THE VOLTAGE DROP IN THE CIRCUIT EQUAL TO 10% OF THE RECEIVING-END VOLTAGE.

THESE CURVES ARE ACCURATE AT ANY POINT TO WITHIN ±1/2 OF 1% OF THE CORRESPONDING %KW VALUE INDICATED AND TO WITHIN ±1/4 OF ONE DIVISION OF THE SCALE THAT INDICATES THE CORRESPONDING %KVA VALUE. THE ACCURACY WAS HELD TO WITHIN THESE LIMITS IN ORDER THAT VALUES OBTAINED FROM THIS CHART MAY BE CLOSELY COMPARED WITH OTHER CALCULATED VALUES.

COPYRIGHT 1958 BY ROBERT S. HORN

Figure 3. The Lucas Chart, showing how much the receiving-end kw load capacity of a line is increased by raising its receiving-end power factor; and just how much capacitance in kva is required to bring about such an increase in load capacity

drop that is within the range of 5 to 15 per cent.

This chart applies not only to lines but to transmission circuits in general, such as a line combined with a sending-end and/or receiving-end transformer. The desired increase in the kw capacity of a circuit and its series R to X ratio are all that have to be known in order to use it.

For this reason it is applicable to lines that have any type of conductors with any amount of spacing, providing the R to X ratio of a line or a circuit consisting of a line and a sending-end and/or receiving-end transformer, falls within the range of the family of curves given.

On this chart the receiving-end load capacity of a circuit in kw is expressed as a percentage of that capacity in kw which it has when the receiving-end power factor is 70 per cent. It was made this way so that it may be applied to any circuit regardless of its operating voltage and the value of its receiving-end load in kw. The power-factor correcting capacitance is expressed as a percentage of the kw-load capacity of the circuit in question so that the chart may be applied to a load of any magnitude, thus making it very versatile.

The Lucas Chart is applicable where the existing load power factor has any value between 70 and 100 per cent. The following example is provided for use as a guide.

Given: A circuit has an R/X value of 0.4 and a receiving-end load capacity of 5000 kw when the power factor of the receiving-end load is 80 per cent and the circuit voltage drop is equal to 10 per cent of the receiving-end-voltage.

To find: The receiving-end kw-load capacity of this circuit when operating with a receiving-end power factor of 95 per cent and a voltage drop of 10 per cent, and also the capacitance in kva required to simultaneously increase the load power factor and the kw capacity of the circuit.

Solution: When Kw_1 indicates circuit capacity in kw when the power factor of the receiving-end load is 80 per cent and Kw_2 indicates circuit capacity in kw when the power factor of the receiving-end load is 95 per cent:

$$Kw_2 = \frac{Kw_1 \times P_2}{P_1} = \frac{5000 \times 185}{122} = 7580$$

when P_1 and P_2 are the per cent values of the circuit capacity in kw given on the chart corresponding to the power-factor values of 80 and 95 per cent respectively for a circuit that has an R/X value of 0.4.

The kva value of the capacitance required to correct the power of a load equal to Kw_2 from 80 to 95 per cent may be determined as follows:

$$Kva_c = Kw_2\left(\frac{P_4 - P_3}{100}\right) =$$

$$7580\left(\frac{69 - 27}{100}\right) = 3180$$

when P_3 and P_4 are the values of capacitance in per cent that are given on the chart below the power-factor values of 80 and 95 per cent respectively.

Where large capacitors are installed, such as 500-kva units, they represent an investment in a package form which can be moved readily and reinstalled elsewhere as changing conditions in a system warrant.

Voltage Rise

If it is determined that the installation of a given power-factor-correcting capacitance would cause an appreciable rise in voltage when it is connected to the end of a line at no load or light load, the use of voltage-controlled automatic capacitor switching should be investigated. Such switching is relatively inexpensive, and as it is voltage-controlled it prevents any appreciable rise in voltage above the desired or selected value at which its control mechanism is set to operate.

In the event that a voltage regulator or tap-changing transformer which has a range of ± 10 per cent, is installed at the end of a line, it will, of course, automatically compensate for a voltage rise of as much as 10 per cent. In such a case capacitor switching would not be required where the voltage rise is within a limit of about 12 per cent.

Several fallacies have been accepted at times concerning power-factor correction as applied to lines. The most important one concerns the range in which it is economical to correct the power factor, which we have just been considering.

Another is that a given amount of power-factor correction increases the kw capacity of a 40-mile line, for example, by a larger percentage than it increases the kw capacity of a 10-mile line, even when the two lines in question have the same conductor size and spacing. The reasoning behind this in some instances is that the 40-mile line has much more reactance than the 10-mile line.

While this is quite true, the amount of reactance is not the thing that governs in such a case. If the per cent voltage drop is the same on both lines, the per cent increase in kw capacity, due to a given power-factor correction, will be precisely the same, since both of these lines have the same R to X ratio.

Another fallacy concerns line voltage drop when it is considered that if a line has a large voltage drop, its capacity will be increased by a greater percentage due to the use of power-factor correction than it would be if it were operated with a lower voltage drop. The Lucas Chart shows the difference in gain at three values of per cent voltage drop when the receiving-end power factor is 100 per cent, and, as may be seen, the gain actually increases somewhat with a decrease in voltage drop except where the R to X value given is more than two.

Fear of an excessive voltage rise when a line is connected to a capacitor during periods when there is practically no other load on the line, is still another fallacy in cases where such a rise does not exist.

The only answer to this is to replace fear with a definite knowledge of just exactly what the rise would be on the circuit under consideration. Engineering is needed here as a substitute for guesswork as it is less expensive in the long run. THE END

Fluid Coke Fuels Unique Plant

CAPABLE OF using up to 500 tons of the new commercial fuel, fluid coke, or fuel oil, or refinery gas, or any combination of the three, the new steam plant of Tidewater's Avon Refinery near San Francisco has many unique features.

From the world's largest fluid-coking unit (its largest tank is over 250 ft high, equal to a 21-story building!), located on the refinery grounds, the fluid coke is transported to the boiler plant by means of compressed air. It is blown in through two 10-in. overhead lines, 1500 ft long, at rates up to 40 tons per hr.

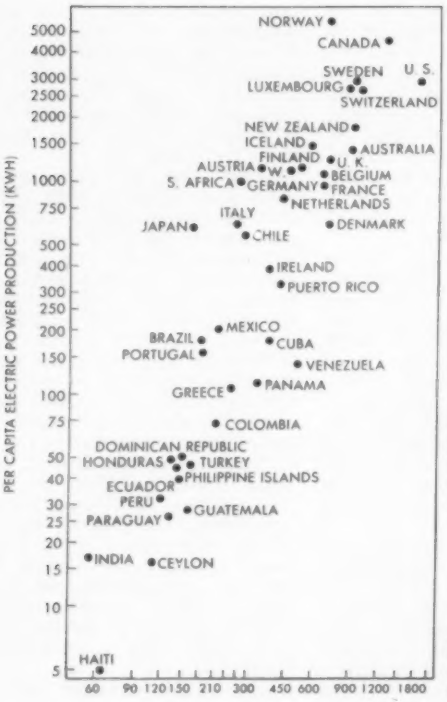
Designed to make 500,000 lb per hr of 1250-psig steam at 950 F, the Riley boiler is an addition to the existing steam plant, and was constructed with provisions for further expansion of the power plant. Avon Refinery, which is 45 years old, now has a capacity of 114,000 barrels per day.

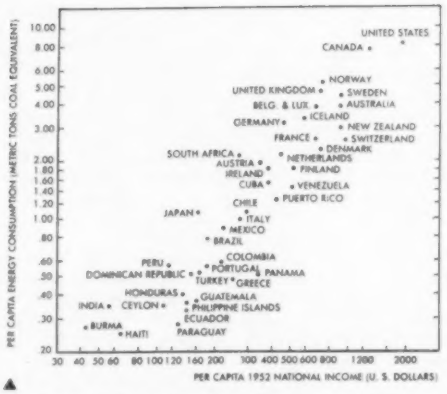
Water for the new boiler is supplied by a fully-automatic 667-gpm demineralizer, which takes suction from an existing clarifying and filtering plant. The ultra-pure water is pumped to the boiler through rubber-lined and plastic-lined pipes, because it is so highly corrosive.

One advantage in burning fluid coke is the small amount of fly ash, amounting to less than one half of one per cent. At Avon this is recovered, not discharged into the air.

New steam plant is the final unit of a three-year expansion program which included, in addition to the fluid-cooking unit, an 88,000,000 gal per day gas-recovery plant, a 24,000 barrel per day hydrodesulfurizer, a 22,500 barrel per day platinum catalytic reforming unit, and other additional facilities. Capacity of the refinery has been increased by 15 per cent.

The Bechtel Corporation engineered and constructed the entire expansion. The Bumstead-Woolford Company subcontracted the boiler work. The automatic demineralizer was furnished by Graver Water Conditioning Co.





Energy consumption vs national income, 1952. Burma, with a per capita income of $43, is credited with a corresponding per capita annual energy consumption equivalent to 0.28 metric tons of coal. The United States, with an annual per capita income of $1900, is shown to have an equivalent per capita total energy consumption of 8.2 tons of coal

Electric power production vs national income, 1952. Based on U. S. dollars, chart shows Haiti with annual income of about $65 per capita, and a corresponding per capita production of electric power of about 5 kwh. Figures for the U. S. are $1900 and 3000 kwh. Norway and Canada, with less income but abundant low-cost hydroelectric power, produce most

Fuel for Tomorrow's Power

How much is there and where will it come from?

IN DISCUSSING fossil fuel resources and world energy consumption, it is convenient to adopt a unit of comparison that will be a few-digit number. A convenient quantity in common use is 10^{18} Btu, represented by the symbol Q. This quantity is also equal to the heat which will be released by the combustion of thirty-eight billion short tons of coal having a heating value of 13,100 Btu per pound.

Thermal energy in the coal, lignite, oil and natural gas resources of the United States in 1944 was estimated to equal approximately 67 Q, which is equivalent to the heating value of 2565 billions of short tons of coal.

Total energy consumption in the United States during 1956 was approximately 0.04 Q. If this is compared with the comfortably large figure of 67 Q, the depletion of our national fossil fuel resources seems a long way off. Such a conclusion is far from the truth.

As the richer and thicker coal seams are exhausted, mining costs will rise. Higher costs of deeper wells and drilling operations in less accessible locations will increase the production costs of petroleum and natural gas. Recent estimates indicate that only about one-tenth of the fossil fuels in the continental United States can be made available for consumption at double present-day production costs.

With regard to world fuel reserves, these have been estimated at around 180 Q, which is the equivalent of about 7000 billion tons of coal. Figures estimating the economically recoverable portion of the world's fuel reserves vary from around 30 to something less than 100 Q.

The world's annual energy use today can be expressed as equivalent to 3500 millions of tons of coal, or 0.09 Q. The rate of use of energy is now approaching 10 Q per century.

Results of various studies predict probable rates of future annual increase in the world's use of energy of from 3 to 4 per cent. If the 4 per cent estimate proves to be correct, the world's store of economically recoverable fossil fuels will be exhausted well before the year 2050.

Fissionable Fuels

Regarding the ultimate total of the uranium reserves in the United States, their estimated energy content has been placed at 28 Q, with an economically recoverable amount equivalent to 14.7 Q in thermal energy.

There has been a general trend in the thinking direction that the economically recoverable fissionable materials from world resources may represent an energy capability between 20 and 25 times the corresponding capability of the world's resources of economically recoverable fossil fuels.

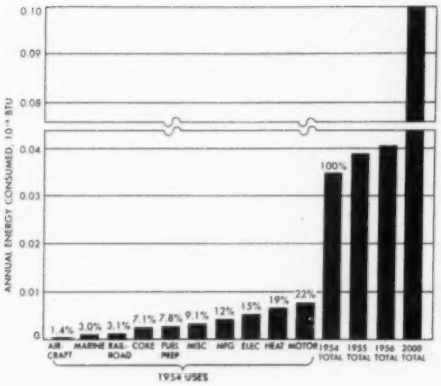
Other Sources of Energy

It has been estimated that hydroelectric power contributed about 0.7 per cent of the world's energy consumed in 1950. For the century following 1950, hydroelectric's total contribution to the world's energy needs has been predicted to equal some 0.6 Q, or only about two per cent of the energy content of the fossil fuels presently considered to be economically recoverable.

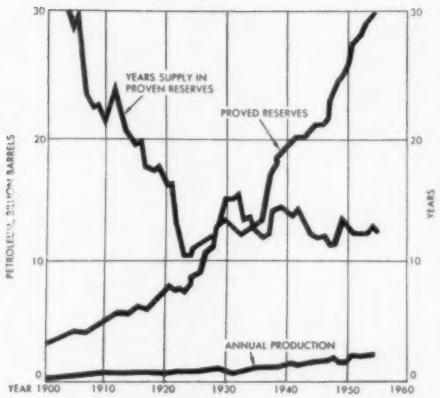
Estimates indicate that a substantial contribution from energy sources for the future will be made in the form of solar heat collectors for comfort heating, cooking, etc.

It has been well publicized that our Atomic Energy Commission has been working on nuclear fusion. An important fuel for the fusion reaction will be heavy hydrogen. Estimates of fuel reserves contained in the water in the oceans range from enough heavy hydrogen to provide fuel for fusion reactors to generate energy at 1000 times the present rate of world consumption for a million to a billion years.

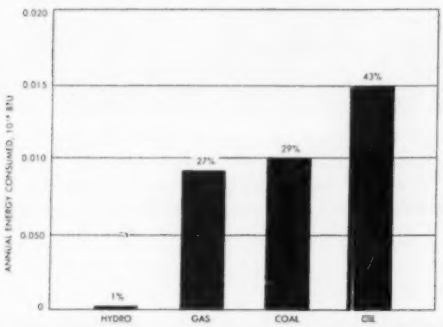
THE END



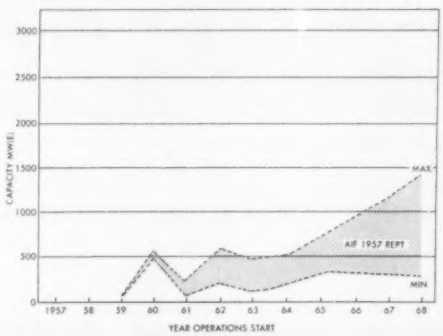
Energy consumption in the U. S. Predicted 2 per cent annual increase in energy consumption will result in a total energy use in the year 2000 approaching 2.5 times the present annual rate. As richer and thicker coal seams are exhausted, mining costs will rise. Higher costs of deeper wells will increase production costs of petroleum and gas



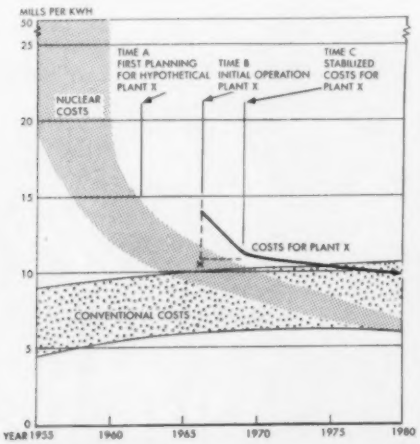
U. S. annual oil production and reserves. It is estimated that oil and gas will supply 75 per cent of our energy in 1975. Estimates indicate that there now exists less than 15 years' life of proved petroleum reserves at the current production rate. There is general concurrence that well-directed steps must be undertaken to develop new sources of energy



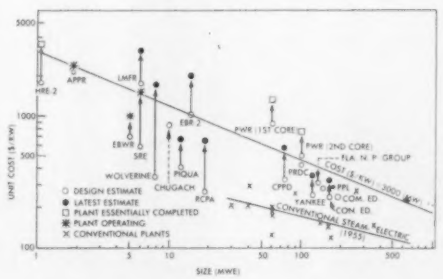
Types of energy sources used in the U. S., 1954. It is most significant that oil and gas are credited with supplying 70 per cent of the nation's energy, coal 29 per cent, and hydroelectric 1 per cent. Recent estimates suggest that only about one-tenth of the fossil fuels in the continental U. S. can be made available at double present production costs



Future nuclear power plant construction. This chart expresses estimates made at the Atomic Industrial Forum held in March, 1957. Given are maximum and minimum figures for the expected annual additions to power generation facilities in the form of nuclear heat source plants. Estimated mean value for 1968 construction is approximately 800 mw

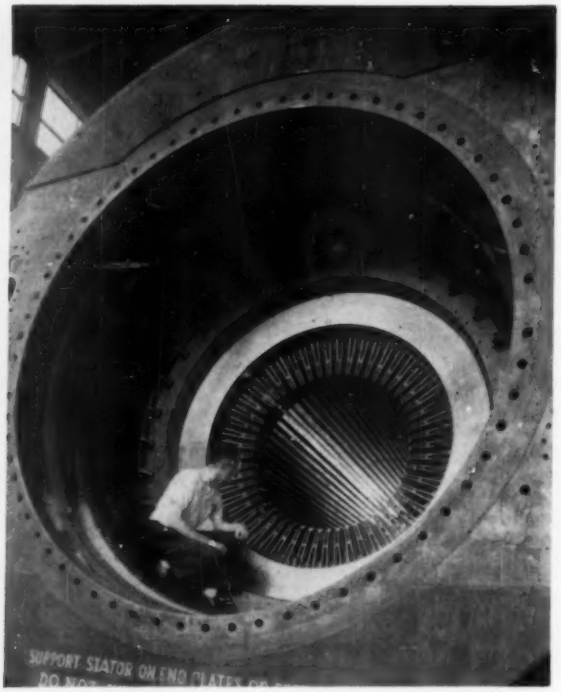


Power costs, nuclear and conventional plants. Chart presented by W. K. Davis and L. K. Roddis, Jr, of the AEC, at Atomic Industrial Forum in 1957. Today's range of estimated nuclear power costs of between 16 and 50 mils is compared with figures for conventional plants of between 5 and 9 mils. Nuclear power enters competitive zone in about 10 years

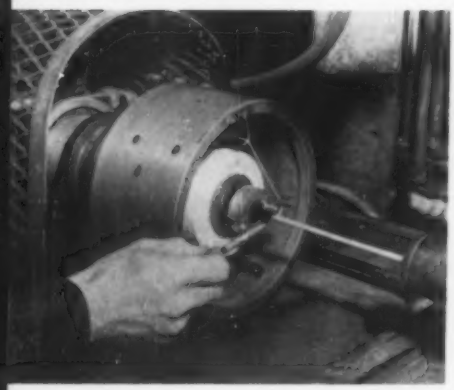


Capital investment cost of U. S. nuclear power plants. Estimated figures for the various nuclear heat source plants are compared with figures for conventional fossil fuel burning stations. Chart indicates upward trend of investment costs between the original design figures and subsequent estimates after construction had progressed. In the range of 30 to 500 mw, the mean lines seem to be at levels which indicate a trend of nuclear plant costs of from two to over three times the figures for fossil fuel burning plants. It is expected that great cost reductions can be effected as experience accumulates for this new type of plant. In any case, increasing power demands and dwindling supplies of national and world fossil fuels necessitate continued concentrated efforts in the building, the testing and the simplification of our nuclear power plants

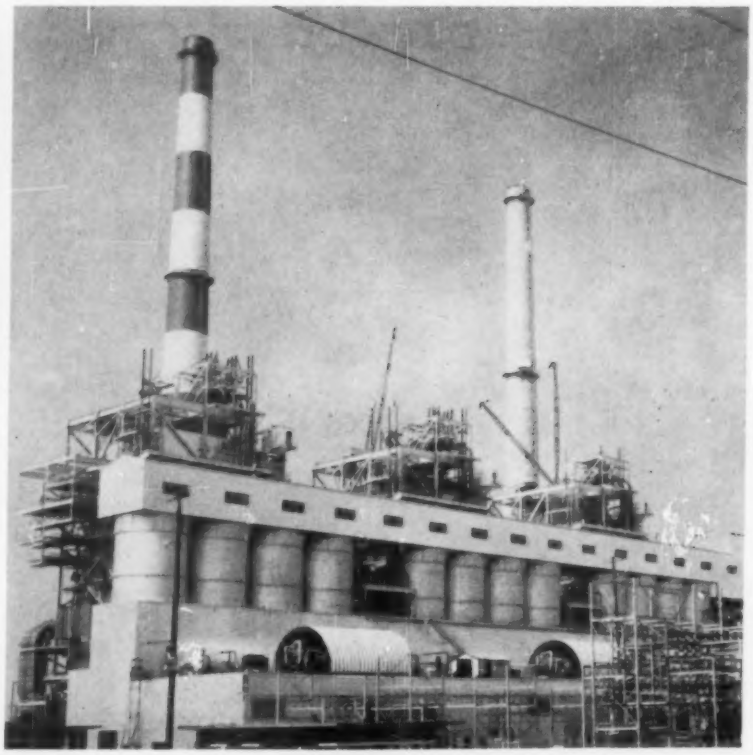
Thimble loading machine moves 18-ft containers of radioactive samples into reactor vessel for testing, at Waltz Mill, Pa., facility of Westinghouse. Machine operates under 18 ft of water for shielding, runs on its own small track



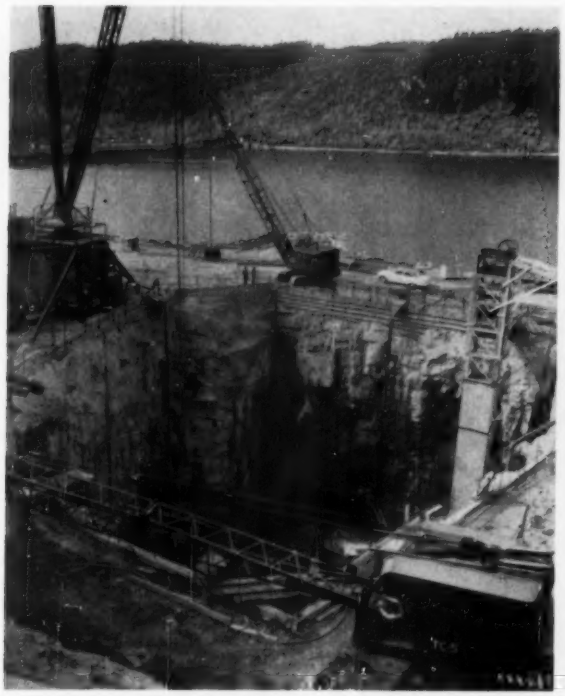
One of two huge generators that are part of the new steam turbine generator unit at Detroit Edison's River Rouge plant. This unit, No. 3, will generate 321,500 kw and will increase the plant's total capacity to more than 840,000 kw



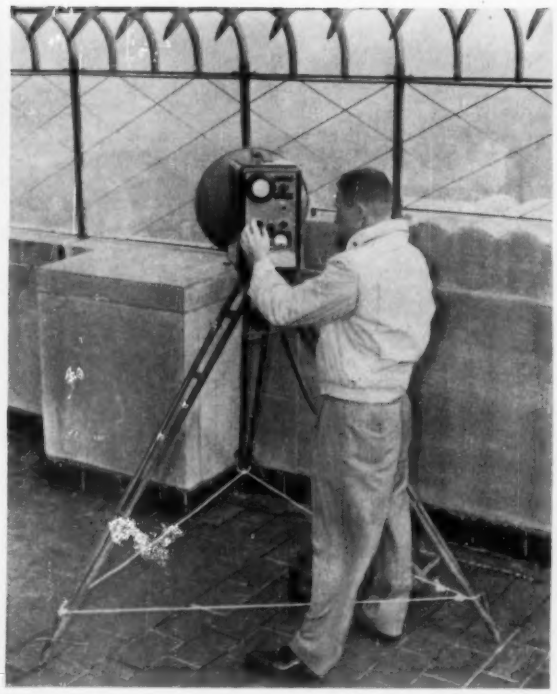
Better wrapper of insulating tape on wire and cable has been developed by Rome Cable engineer. It runs at 4000 rpm, has sealed-in bearings' lubricant, mounting which cuts vibration



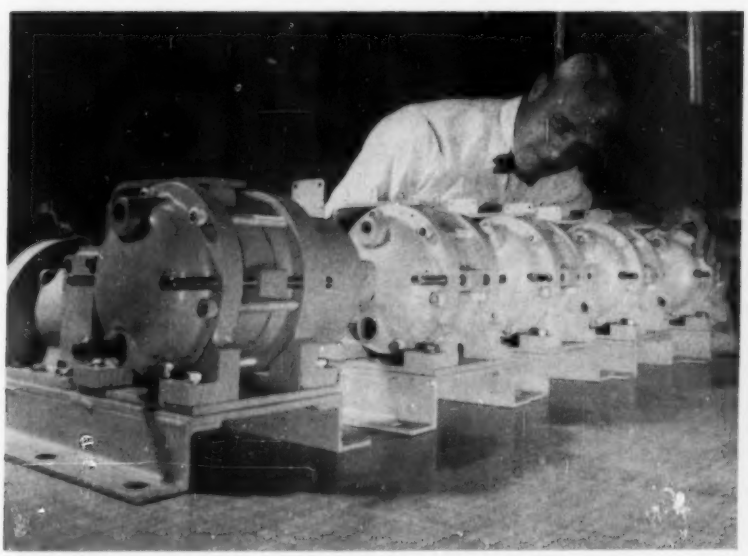
Warrick Power Station, now under construction near Evansville, Ind., for a subsidiary of ALCOA, is a 3-unit, 375,000-kw steam electric generating plant. Shown are turbine deck, coal silos, top and penthouse area of the three aluminum-covered boilers, stacks



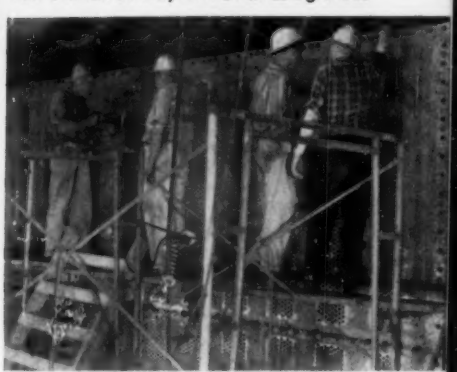
Underground powerhouse of 1,000,000 hp is being built by Aluminum Co of Canada at Chute des Passes in Quebec Province. Six-mile tunnel to plant has intake projecting 600 ft under reservoir. This shaft leads to it



Electronic survey of Manhattan Island, taken from top of Empire State Building by Tellurometer, in 20 min measured length of island at 13.08 miles. Microwave mapping took 3½ hours as compared to 5 days for conventional transit



Not motors but differential pressure detectors. These G-E instruments will sense the flow of steam and water from steam generator to turbine in feedwater loop for the Triton, newest nuclear submarine. **Below:** first condenser with welded tubes instead of rolled is made by Allis-Chalmers for Tait Station of Dayton Power & Light Co.



POWER ENGINEERING'S NEWS REEL

Fig. 1. Concentrations of hydrazine in boiler water may be easily determined, using either photometers or color slides

Oxygen-free steam and condensate are requisite for corrosion-free operation in the modern system. When older methods of control result in undesirable high solids levels in the system . . .

Hydrazine Assures Effective Deaeration

By JOSEPH R. COURSAULT*

DEAERATING HEATERS in common usage for removal of noncondensable gases from boiler feedwater can reduce dissolved oxygen to a low level. Nevertheless, industrial plants and utilities normally find the use of a chemical deaerant advisable to minimize the difficulties with oxygen corrosion and pitting from the residual oxygen present in the boiler feedwater. For many years sodium sulfite has served the purpose of removing the residual oxygen from the boiler feedwater. While sodium sulfite has served effectively for this purpose, especially for boilers operating at moderate pressures, difficulties have been experienced at higher pressures of operation. The difficulties originate from the acidic decomposition of sulfite at high pressures.

Sulfite can decompose to sulfur dioxide (SO_2) or hydrogen sulfide (H_2S). The tendency for the dissociation increases as the pressure increases. As a consequence, the requirement for a chemical deaerant which would not possess this inherent disadvantage of acidic dissociation has become increasingly apparent.

A few years ago reports of successful applications of hydrazine in Europe were received. As a result, considerable interest was aroused in the United States concerning the possible use of this material for deoxygenation.

Hydrazine has the formula N_2H_4, and was originally developed as a rocket fuel. Hydrazine is a colorless liquid with a distinctive smell. It is completely soluble in water to form alkaline solutions. For boiler feedwater purposes, hydrazine is normally obtained as a 35% solution in water. The 35% hydrazine solution has no flash point. This fact accounts for the popularity of that strength solution for feedwater treatment.

The freezing point of the 35% solution is −146 F; the boiling point 228 F. Specific gravity is 1.025. Hydrazine liquid and concentrated vapor are toxic, and for that reason the usual care in handling toxic materials must be employed in feeding.

High Pressure Speeds Reaction

While sodium sulfite effectively stifles oxygen corrosion and pitting, the acidic hydrogen sulfide or sulfur dioxide decomposition products of the sulfite may cause serious corrosion problems in themselves. Unlike sulfite, hydrazine will dissociate to form an alkaline material. Since the breakdown of hydrazine occurs at high pressures, the use of hydrazine is particularly attractive to utilities and industrial plants with boilers operating above 600 psi. For plants of this type, hydrazine possesses another distinct advantage over and above the freedom from acidic decomposition.

Solids Level Critical

The greater the pressure of operation, in general, the more critical becomes the dissolved solids content of the boiler water. Naturally, the addition of sulfite, a solid material, adds to the dissolved solids content of the boiler water, since sulfite reacts in accordance with the following equation:

(1) $2NA_2SO_3 + O_2 =$
sodium sulfite + Oxygen
$2NA_2SO_4$
sodium sulfate

In many cases the sodium sulfite added for chemical deaeration contributes the major portion of the dissolved solids of the boiler water for high pressure boilers using evaporated or demineralized makeup.

With the use of hydrazine for deoxygenation, chemical deaeration is achieved without the addition of any solids to the boiler water since hydrazine will react with oxygen in accordance with the following equation:

(2) $N_2H_4 + O_2 =$
Hydrazine + Oxygen
$2H_2O + N_2$
Water + Nitrogen

As indicated in the above equation the direct reaction of oxygen with hydrazine produces gaseous nitrogen and water, thus adding no solids to the boiling water. Theoretically, only one part of hydrazine is required for each one part of oxygen. However, in practice it is usually found that about 1.5–2.0 parts of hydrazine are needed for each part of oxygen in order to maintain a positive hydrazine residual. Normally a hydrazine residual of 0.1 ppm or less is maintained in the boiler water to achieve desired results. A large excess of hydrazine will promote dissociation of the hydrazine in accordance with the following equation:

(3) $3N_2H_4 = 4NH_3 + N_2$
Hydrazine = Ammonia + Nitrogen

The dissociation of hydrazine to ammonia will naturally raise the pH of the condensate. This condition is accepted with favor since the ammonia will offer some protection from corrosive attack by carbon dioxide in the condensate through the process of neutralization. However, careful control of the hydrazine feed is desirable in order to restrict the opportunity for development of too high ammonia concentrate in the steam and condensate, since the ammonia, particularly in the presence of any oxygen, can readily attack copper or copper bearing metals in the return system. Normally copper attack will not be a factor if the hydrazine feed is so controlled that the pH of the condensate is not permitted to rise above 9.0.

---

*Engineering Dept, Betz Laboratories

In initiating hydrazine feed to boiler feedwater in a stoichiometric quantity based on the oxygen in the feedwater, an excess hydrazine residual is normally not found in the boiler water for several days. This fact, correlated with other substantiating evidence, leads to the conclusion that hydrazine does not always react directly with oxygen as shown previously in equation No. 2.

It is particularly evident that the hydrazine does not react directly with the oxygen at temperatures below 400 F. Experimental evidence indicates that the hydrazine undergoes a heterogenous surface reaction with iron in accordance with the following equations:

(4) $6\,Fe_2O_3 + N_2H_4 =$
Ferric Oxide + Hydrazine =
$4Fe_3O_4 + N_2 + 2H_2O$
magnetic iron oxide + Nitrogen + Water

(5)
$4Fe_3O_4 + O_2 = 6Fe_2O_3$
magnetic iron oxide + Oxygen = Ferric Oxide

Evidence to substantiate the validity of the above two equations includes the fact that often two weeks are required when using hydrazine in 100% excess of the stoichiometric requirement before any hydrazine residual is detected in the boiler water. It appears that this time is required for the hydrazine to reduce all the ferric oxide in the system and, then only on completion of this reaction, is it possible for the excess hydrazine to build-up a residual or to produce any ammonia. Further contributory evidence is the fact that the iron oxide in the boiler changes from a red-brown color to black. When the feed of hydrazine is discontinued to a system which continuously employed this deaerant, oxygen free steam is produced for a considerable period of time after the discontinuance of the hydrazine feed. A likely explanation for this phenomenon is that the reduced oxides continue to remove oxygen until such times as all the oxides are reoxidized.

In high-pressure boiler operation in the utilities, the deposit normally found in the boilers at inspection consists of the oxides of iron and copper. There have been reports that with hydrazine feed the amount of such deposit is less than when sulfite is fed for chemical deaeration. A review of the data available indicates that for central station operation the average requirement for 35% hydrazine solution is 5 pounds per year for every one thousand kw generating capacity.

Reductions of Deposits Noted

Since the use of hydrazine in this country is relatively new, some comments on actual case histories may be of interest. A utility in the East which formerly used sulfite for the removal of oxygen from the feedwater is now using hydrazine. It was reported that at the time of boiler inspection, appreciably less deposit was noted in the boiler. The deposit found was characteristic of a hydrazine treated boiler, consisting of a black powdery deposit of iron oxide, easily brushed or washed off. Personnel at this utility were even more pleased, however, with the marked decrease in solids concentration of the boiler water during operation. With the decrease in solids a substantial decrease in the rate of blowdown was permissible, thereby markedly reducing the requirement for makeup water. With the reduction in makeup, savings in demineralization costs followed. With the substitution of hydrazine for sulfite, dissolved solids and silica concentration are easily maintained below the maximum limits, by allowing a reduction in makeup requirement, and necessitating only a nominal blowdown rate.

An Aid to Quick-Start Units

In addition to the use of hydrazine for chemical deaeration during normal operation, many have found the use of hydrazine advantageous for boiler storage. For this purpose, up to 100 ppm of hydrazine are maintained in the boiler water. Sometimes supplemental ammonia is added to the system for pH adjustment. This use of hydrazine is especially desirable for utilities that may have sudden call for placing an idle boiler in operation. If chemicals other than hydrazine are added to the boiler for protection during storage, appreciable dissolved solids will be present in the boiler water. With the use of hydrazine, while good protection from corrosion is afforded, there are no solids added to the boiler water. For that reason, a boiler so protected will be quickly placed back into service.

In some instances, the conventional feed of sulfite to an industrial boiler, that is, the feed of sulfite that is not catalyzed and which is fed at normal dosage, will not provide complete protection for economizers. Attention was given to such an industrial boiler which substituted the feed of hydrazine for sulfite in an effort to better protect the economizer section. Inspection of the economizer after a normal operating interval showed that the pitting attack of the economizer had been stifled. Since rapid reaction of the hydrazine with oxygen is believed to be completed only at temperatures above 400 F, the subject experience is further evidence of the heterogenous surface reaction of hydrazine with ferric oxide instead of the direct reaction of the hydrazine with oxygen.

The hydrazine solution is conventionally injected in continuous fashion to the boiler feedwater, or in some cases to the condensate. Continuous introduction of the hydrazine is desirable for the usual reasons of permitting stability of residuals and to assure continuous protection from oxygen attack. If hydrazine were to be fed in shot fashion, high hydrazine concentrations would be present following each shot. High hydrazine concentrations would permit development of unfavorably high ammonia levels in the steam. The hydrazine solution should be introduced continuously in order to maintain a small excess hydrazine residual in the boiler water after the hydrazine has been in use for two weeks.

There are two tests available for checking the hydrazine residual. One utilizes a colorimetric slide while the other employs a photometer. Hydrazine is compatible with most boiler treatment chemicals. THE END

References

1. Ongman, Harry D., *Combustion*, 39–44, Feb, 1953.
2. Dickinson, N. L., Felgar, D. N. and Pinch, E. A., *Proceedings of American Power Conference*, XIX, p 269–702, 1957.
3. Leicester, J., Hydrazine and Water Treatment, *Proceedings International Conference*, Bournemouth, England; p 33–53, May, 1957.
4. Power Engineering, p 89, Sept 1956.
5. Hess, Robert T., and Wofford, Andrew W., Power Engineering, pp 80–84, Sept 1955.

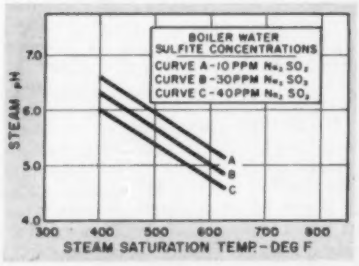


Fig. 2. Chart showing how decomposition of sodium sulfite at high temperatures affects the ultimate pH value of steam

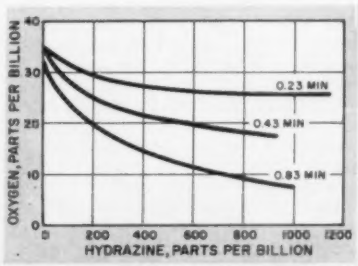


Fig. 3. Dissolved oxygen concentrations vary with time of reaction with hydrazine as indicated in the above chart

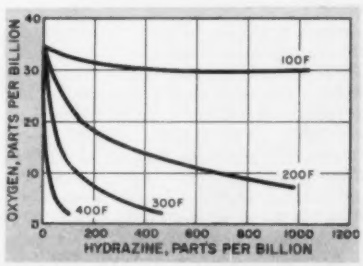


Fig. 4. Hydrazine-oxygen reactions are influenced by temperature, with lower concentrations required as temp. rises

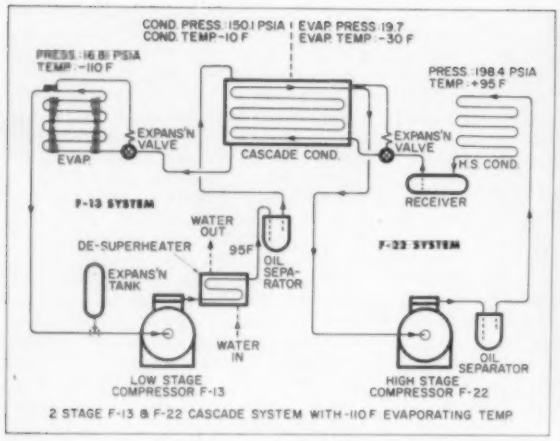


Fig. 1. This type of refrigeration system is the one universally accepted today as most efficient for testing units

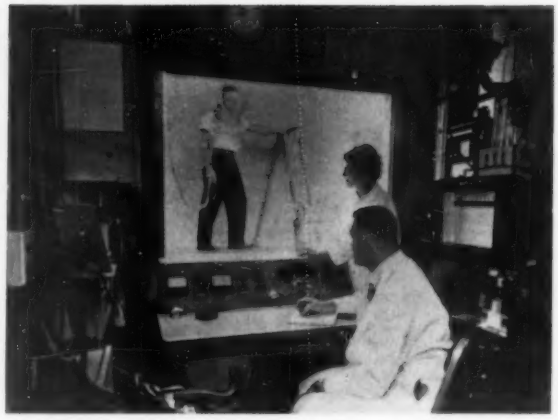


Fig. 2. This testing chamber—being used in studies of body metabolism—is an airtight room measuring 13 by 9 by 8 ft

What's in That Testing Chamber?

Extreme heat, cold, humidity, altitude and many other environmental conditions imposed by nature are now being made by man as part of the process of modern testing—and power makes it all possible

By FRED HERMANN*

SINCE the mid 1940's, environmental simulation has become a major factor in product testing, storage and general manufacturing. Biggest of these fields is the simulation of environments to determine product workability and reliability under extremes of temperature, humidity, altitude and other climatic conditions. Storage, usually at extremely low temperatures, involves maintaining products' initial characteristics and properties. In manufacturing, environmental tests are made for such processes as metal hardening at extremely low temperatures, chemical process work, shrink fitting, and the like.

Sudden and drastic demands of World War II did not allow sufficient time for laboratory testing and developing of aircraft components. The aircraft manufacturers virtually built air frames and components from the drawing board, and much of the flight worthiness of a particular craft was determined by initial flight tests. But altitudes and flight speeds were rather moderate as compared to the magnitudes reached today, and the amount of stress on a particular craft was not as critical as that now being experienced.

Additionally, the cost of aircraft and missiles currently being developed and manufactured is, by comparison with the World War II era, so high that we cannot afford the luxury of launching a piece of equipment without prior reliability testing of all components. Failure of a single component in flight can destroy several millions of dollars worth of equipment.

Aircraft and missile industries are undoubtedly the largest users of environment simulating equipment, since aircraft and missiles encounter the greatest number of environments at their uppermost extremes. Modern aircraft are capable of flying at altitudes in excess of 60,000 ft and at speeds which can be in excess of Mach two.

An aircraft, therefore, would encounter high temperature that might exist on the ground and rapid descent in temperature during its climb, coupled with a rapidly decreasing absolute pressure. During ascent as well as during level flight the aircraft is subjected to extreme forces of acceleration and vibration of various complex wave forms which must also be considered either separately or in combination with one or more of the environments encountered.

Environmental testing is particularly concerned with such areas of natural environment as temperature, humidity, altitude, solar radiation, sand and dust, rain and salt fog atmosphere. A missile or an aircraft could encounter any or all of these environments during its useful life. Any one of these environments can lead to a failure and it is highly probable that two or more in combination could cause a failure which would otherwise not be evident. It is therefore necessary thoroughly to subject individual component parts, subassemblies, and in some cases the entire assembly, to environments in the combination in which they are likely to be experienced.

An environmental simulation chamber consists primarily of a test enclosure, refrigerating, heating, humidifying, and/or evacuating equipment and the controlling instrumentation and accessories. As recently as ten years ago, altitudes of 50,000 or 60,000 ft were the maximum required, with temperature levels of only minus 30 or minus 40 F. More recently, however, these requirements have been expanded to such a degree that we have had to develop systems capable of temperatures as low as minus 150 F, altitudes of 500,000 ft, and high temperatures of plus 1000 or 1200 F.

Up to 1950 it was common practice to employ a compound refrigeration system using two or three stages of compression with a refrigerant such as Freon 22 to produce temperatures as low as minus 100 F. This system was highly inefficient and extremely complicated in construction as well as in operation. It operated at the very limit of the refrigerant, and the low stage compressor unit had to op-

*Developmental Engineer, Tenney Engineering, Inc

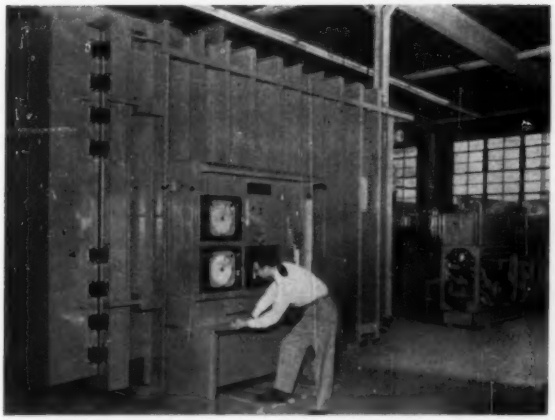


Fig. 3. This huge chamber will accommodate a 6000-lb vibration machine under extreme altitude, temperature and humidity conditions. The Tenney unit can dissipate 16 kw (about 56,000 Btu) at minus 100 F. Isolation of vibration equipment is achieved by 20-ton concrete block under unit

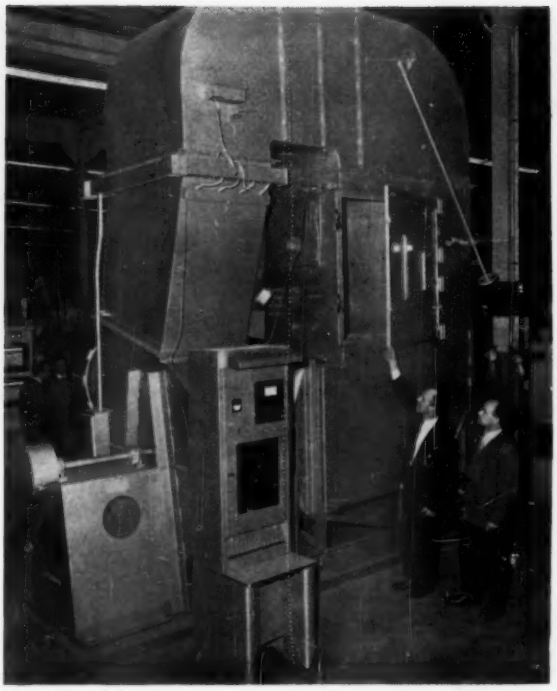


Fig. 4. Sand and dust storms are made in this environmental test chamber made for the French government's missiles, rocketry and supersonic aircraft development program

erate at inlet pressures as low as 26 and 27 in. of vacuum.

Early in 1951, Tenney Engineering, Inc, introduced a refrigeration system of the cascade type using high pressure refrigerants, Freon 22 and Freon 13. This type of system (Fig. 1) has become universally accepted. It is extremely efficient, with much smaller compressors and consequently smaller motors. Its operating costs are at a minimum. More recently other refrigerants have been investigated, such as the newly developed Freon 14, in cascade with Freon 13 and Freon 22, to allow faithful creation of such temperatures as minus 180 to minus 200 F.

The variety of test chambers is unending, with working volumes as low as one cu ft to allow for the testing of small electronic components, and as large as several thousand cu ft to allow an entire aircraft fuselage or a missile to be tested in a single piece. A recent chamber by Tenney measures 14 by 14 by 35 ft. It has temperature capabilities of minus 100 to plus 1200 F, and an altitude simulation from sea level to 120,000 ft. It undoubtedly is one of the largest installations with such a range and combination in the world.

Power Requirements

Since test chambers are produced in such a variety of sizes with varying loads and environmental extremes, the power requirements for such chambers vary over a wide range.

A typical 10 cu ft test chamber with a range of minus 100 F to plus 250 F would have two 3-hp refrigeration compressors and 4 kw of electrical energy for heating. The control circuit would perhaps add another 0.25 kva to the entire system.

On the other hand, a recently designed altitude chamber with dimensions of 12 by 14 by 18 ft, and performance of minus 100 F to plus 350 F and 120,000 ft of altitude, would have a refrigeration system consisting of two 75 hp compressors and two 60 hp compressors for the cooling. The vacuum pumps, which are designed in a series system, consist of a 75 hp pump, two 60 hp pumps and one 40 hp pump.

For sake of flexibility, the refrigeration system has been divided into two units, thus allowing continuing operation at partial loads should there occur a breakdown of either of the systems.

In addition to the loads above, this chamber has 160 kw of electrical energy for heating as well as two 3-hp blower motors for air circulation within the chamber.

These figures demonstrate the extremes of power requirements which might be encountered in some units.

Here is an example of the use of environmental chambers in manufacturing: conventionally, the outer one of two items to be joined is heated to cause it to expand and allow free insertion of the inner mating part. The two parts would then be held together firmly as the outer member, on cooling, returned to its normal temperature. Expansion by heating has many problems, however, the foremost of which are oxidation on the skin of the material and warping or deformation due to the application of high temperature.

With low temperatures available to such magnitudes as minus 100 to minus 150 F, it is now possible to shrink the inner part of a mating assembly, install it into the larger outer ring and then allow the cooled part to return to normal temperature and size. This has eliminated warping and oxidation problems and has made possible the mating of extremely critical items without change in shape.

Temperature and humidity simulation is important in many industries. In power, for example, there is testing of motors, and cables are tested to determine how their coverings hold up. In packaging there is testing of adhesives and closures; in plastics, the development and testing of new materials; in photography, the development of new films and film coatings. Foods, chemicals, textiles and automobile parts are a few of the many products developed and tested under created climatic conditions.

Environmental simulation is a growing field with every prospect of becoming even more important as science advances and men demand products of the highest quality on earth or in tomorrow's world of outer space. THE END

Transistors Versus

Are transistor systems replacing magnetic amplifiers? What are the main areas of competition? What factors ensure the survival of saturable-core techniques? The author answers these timely questions

By A. G. MILNES*

IN THE LAST DECADE magnetic-amplifier and saturable-core techniques have been of great prominence in the field of electro-technology for regulating and control purposes.

Applications include voltage control of large synchronous generators, frequency and voltage regulation of motor-generator power systems (particularly in military applications), regulated d-c and a-c line power systems, static relay protective systems, measurement of large d-c busbar currents and numerous applications as servo-amplifiers for systems as complicated as aircraft autopilots and missile guidance schemes.

Within the last year or two transistors with adequate range of performance have become widely available. With transistors rated at 100 volts, and tens of amperes, with permissible junction temperatures of up to 90 C for germanium and 150 C for silicon units, the reign of the magnetic amplifier appears seriously challenged.

Some key features of the two techniques of amplification are set out in the table. Magnetic amplifier power supply frequencies are typically in the range 60 cycles to 10 kilocycles per second. The higher the frequency the smaller the size of core required for a given output. The size of a single-stage magnetic amplifier is several times that of a transformer of comparable rating. Up to medium power levels (say 100 watts) the amplifiers are of expensive nickel-iron alloys, with toroidal windings.

Instant availability feature of the table refers to the absence of the warm-up time needed in thermionic tube amplifiers.

A-c amplification in magnetic amplifiers requires the signal frequency to be considerably less than the supply frequency which acts as a carrier. Alternatively the signal and supply must be identical in frequency, a condition that is not too restrictive in position-servo-control systems.

Both types of amplifiers are robust and reliable to a degree determined by the attention to detail given in manufacture. The simplest magnetic amplifier circuit requires two semiconductor diode rectifiers and an equivalent Class-A transistor amplifier requires one transistor — each involves two rectifying junctions.

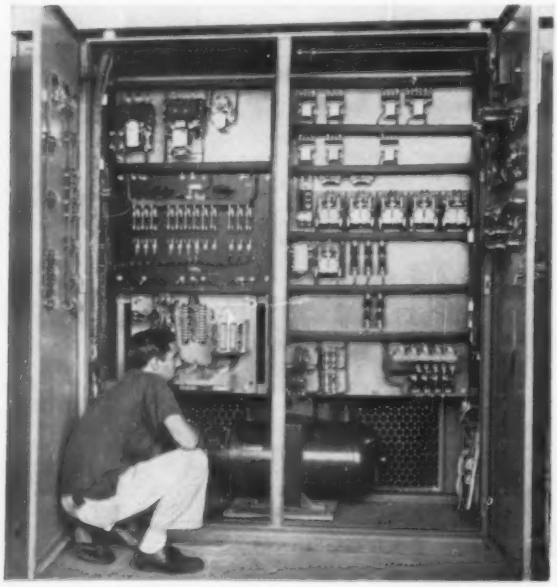
Temperature sensitivity of transistor parameters can cause considerable gain change and drift over any substantial ambient temperature range, such as −60 to 100 C, whereas magnetic amplifiers may have zero stabilities of 10^{-9} watt (in terms of input signal power), and gain stabilities of a few per cent over this range. Magnetic core parameters are relatively insensitive to temperature effects up to ambients of several hundred degrees C since Curie temperatures are of the order of 350 to 550 C for nickel-iron alloy.

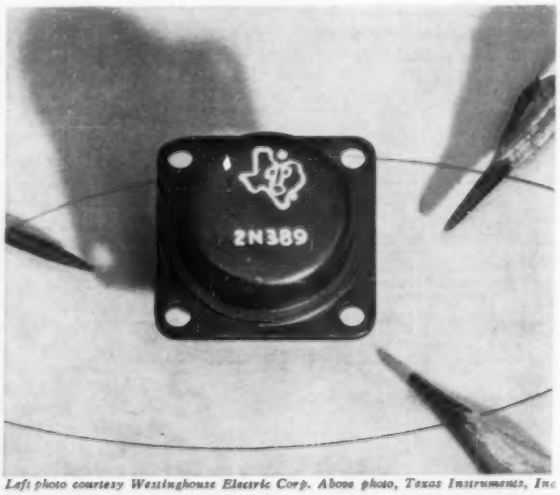
Temperature sensitivity of transistor amplifiers can be reduced by use in a switched mode of action. Gating action reduces the power dissipation in the transistors, since when the current is high the voltage is low and vice versa. This increases the efficiency and power handling ability of a given unit. Class B amplifiers may be increased by a factor of three or more in power rating at high temperatures by switched action.

Magnetic amplifiers essentially depend on periods of core flux saturation for transmission of power to the load and are therefore inherently of switch-type action. The chopped waveforms produced by this switch action can cause troublesome interaction problems in multiple-stage magnetic amplifiers.

In general the dynamic performance of a magnetic amplifier presents difficulties in complex systems.

* Associate Professor of Electrical Engineering, Carnegie Institute of Technology





Left photo courtesy Westinghouse Electric Corp. Above photo, Texas Instruments, Inc

Fig. 1. (Left) Typical magnetic amplifier system designed to regulate conveyor speed and position. Amplifier is at the lower left. Fig. 2. A silicon power transistor. Increased power and temperature ratings are making it competitive

Magnetic Amplifiers

In voltage regulation of large synchronous generators this may not be so, since the field time-constant, of say 10 seconds, may be dominant. A two-stage magnetic amplifier for such a system may have a power gain of 100,000 with an overall response time of 10 cycles of the 60 cps supply frequency. With the magnetic amplifier feeding into a booster-exciter the overall system may correct voltage surges caused by heavy load switching in less than a second.

The basic expression for the time-constant of a single-stage magnetic amplifier is of the form

$$\tau = K\left(\frac{V_A}{f}\right) \text{ seconds}$$

where V_A is the voltage amplification, f is the supply frequency, and K involves the ratio of control to gate winding turns and typically may have a value from 1/2 to 1/20

Certain magnetic amplifier circuits with a response times of one-half cycle of the supply frequency are in wide-spread use but these have low gains that conform with the expression given above.

In many position-servo-control systems the requirements of high gain and (perhaps) one-cycle response are such that they can be barely met by magnetic amplifier systems operating from 60 or 400 cps supply sources. Various techniques of supply frequency multiplication have been proposed to remedy the situation, but these add complexity and may present difficulties of their own.

For this reason the area of high-performance servo-control systems is in process of becoming transistorized.

To some degree the problems of dynamic performance of magnetic amplifiers have been exchanged for the temperature problems of the transistor amplifier, but with the prospect of a fairly substantial reduction in weight and size as the attractive feature. The grounded-emitter cut-off frequencies of power transistors are in the range of tens of kilocycles which usually allows adequate servo-amplifier performance without too serious a phase-shift problem in connection with gain and phase margins of the system.

Although the main outline of magnetic-amplifier technique is well defined there are still areas of operation that are very imperfectly understood. Inductive and capacitive load behavior under dynamic conditions is of importance in many applications and yet analysis here is difficult. Confusion may exist because of lack of unifying circuit studies in areas such as servo-amplifier classification and complex feedback techniques. The engineer developing magnetic amplifiers is therefore likely to find his path less clearly defined than in transistor technology and turn to the latter with relief.

Summary of the principal characteristics of magnetic and transistor amplifiers

	MAGNETIC AMPLIFIERS	TRANSISTOR AMPLIFIERS
General		
	A-c power supply	D-c or a-c supply
	Instant availability	Instant availability
	A-c or d-c signals	A-c or d-c signals
Good		
	Robust and reliable	Robust and reliable
	Isolation of inputs	Small in size
	Temperature characteristics	Dynamic performance
	Large powers	Linear characteristics
	Zero stability	Switched operation
Bad		
	Dynamic performance	Temperature sensitive
	Waveforms	Present v-a limits are low
	Size and weight	Surge protection

Magnetic-amplifier research requires careful design of experiments, keen observation and analytical skill in extracting and presenting conclusions in useful form. This is excellent for educational purposes in research.

However, to the straight question as to whether any further major circuit developments may be expected from such work the answer must be negative.

For instance, the time-constant versus voltage-gain relationship quoted earlier is a barrier based on Faraday's Law, and cannot be brushed aside, although the possibility exists of minimizing the effect in various, cumbersome ways.

In multi-stage magnetic amplifier systems one trend has been towards the replacement of input stages with transistors to improve dynamic performance. The power dissipations in such input stages are low, so temperature stability problems are not too severe.

More recently the development trend has been towards switched output transistor stages with magnetic amplifier switching drive. The use of a small magnetic-amplifier intermediate stage to provide the pulse-length-modulated base-drive required is effective and convenient in many applications, even though an a-c power supply may have to be provided for the amplifier.

Although transistor and other semi-conductor devices may take over the functions of magnetic amplifiers in the future, there are several aspects of magnetic-core behavior that ensure the continued use of many related core techniques.

An obvious example is the unique property of transformer type coupling which provides isolation of potential levels between parts of circuits. The philosophy here is that if the core has to be present as a transformer it may also be convenient to use it in a more elaborate fashion.

A second important feature of magnetic cores (particularly square-loop cores of high retentivity) is their capacity for flux storage. This together with a well-defined saturation level permits counting functions to be performed — a feature used in the instrumentation of satellites. The storage function implies also a delay action that is convenient in the construction of shift registers and other digital computer applications.

Symmetry of core magnetization characteristics is a further valuable feature. This is exploited in magnetic-core choppers, or modulators, in which an even-harmonic output is obtained only in the presence of a symmetry created by a d-c signal. The drift level in such modulators is in the range of 10^{-13} to 10^{-16} watt (expressed in terms of input signal power), depending on the degree of circuit refinement. The ultimate limit set by Barkhausen noise is believed to be considerably lower than 10^{-18} watt in normal molybdenum-permalloy cores. THE END

References

Transistor Circuits and Applications, Proc. IEE (London), 1957, Vol 104B, p 565

Transductors and Magnetic Amplifiers, by A. G. Milnes, St. Martins Press, 1957

About the Author

In his present position, Dr. Milnes' interests now lie with semiconductor devices and transistor circuit techniques. However, this has been preceded by many years of study in saturable-core techniques. His book, Transductors and Magnetic Amplifiers, is recognized as an important contribution in this field.

With this background, Dr. Milnes is well qualified to review the conflict between techniques.

Have You Tried NISA?

By PAUL M. SIEVERT

Paul M. Sievert heads NISA, also the Sievert Electric Co

ENGINEERS who operate and supervise power generation and electrical equipment in manufacturing plants, utilities, mines and other establishments should be familiar with the good, independent, electric motor, generator and transformer service shops in their areas.

Chances are, they do business regularly with one or more of these companies, because it is estimated that these independent shops presently handle 75 per cent of all the motor rewind business in the United States plus a smaller share of routine electrical maintenance and minor repair of electric motors.

Rest of the rewind business is done in about 1500 company-owned or "captive" shops and in some 100 service shops operated by the large motor manufacturers. Some minor business is also done by service men who repair appliances, air conditioning units and the like, although many of these service men deal regularly with independent shops.

Just how many independent shops there are in the United States no one knows for sure. In 1954, the U. S. Census attempted to determine the number, but because many independent shops are operated by companies that also are engaged in electrical contracting, wholesale and retail supplies, even manufacturing, the results were somewhat inconclusive. (The Census counts "establishments," not departments or divisions of a company.)

More light may soon be thrown on the subject with the completion of a survey conducted by NISA, the National Industrial Service Association, the international trade organization of electric motor, generator and transformer service and sales shops, and by the National Electrical Manufacturers Association. The results are to be announced shortly.

But it really isn't important to know how many shops there are. Estimates range as high as 8000, and if this figure is accurate, which is doubtful, it would have to include hundreds of one-man "alley" shops, highly transitory in nature, which could not begin to service America's industry in the manner in which it is being serviced by the many outstanding shops located in every important city in the nation.

What is important to the engineer concerned with quick, efficient, economical servicing and repair of his electrical equipment is that there are at least 1600 *good* shops on the North American continent, ready to step in at any hour of the day or night, repair his motor off or on the premises, or, if necessary, replace it with an adequate substitute while the burned-out motor is taken to the independent shop long enough to be completely repaired according to the owner's and manufacturer's specifications.

Equally important to the engineer is that there are 1600 shops that can also rewind his electrical equipment to meet his exact needs, producing in many cases a better motor than the original. These are the same shops that have been instrumental in the pioneering of special treatments and processes such as silicone insulation, epoxy encapsulation for adverse chemical or other conditions, etc.

These 1600 shops may be departments of larger companies as mentioned above; they may also be engaged in the sale of electrical equipment; or they may be purely repair shops. They may have just a few employes or they may have a payroll of 200 persons. Some of these shops are more than 50 years old.

Most of them deal principally with industrial firms, although they are capable of handling all types of commercial work such as the hermetically-sealed motors in appliances.

There are many graduate engineers in the service shop business, ready to tackle complicated problems involving electronic equipment.

These 1600 shops are the NISA shops, members of a 25-year-old trade association, founded in 1933 for cooperative self-improvement.

Growth of NISA

In the beginning NISA (National Industrial Service Association) was operated out of a member's office. Today it boasts of an executive staff composed of an executive vice-president, a staff engineer, several office assistants, a mail room where bulletins, announcements and engineering data are mailed regularly to members in every state in the U. S. and all the Canadian provinces. The association publishes a national magazine, provides its membership with advertising, sales and publicity aids. Its engineering data file is the largest of its kind in the world.

Shop with a knotty problem in, say, Alaska, will call the NISA staff engineer, get his answer in a matter of hours, saving a customer countless days of expensive downtime. The engineer frequently puts members in touch with one another, so that a replacement motor can be located quickly and shipped to the customer.

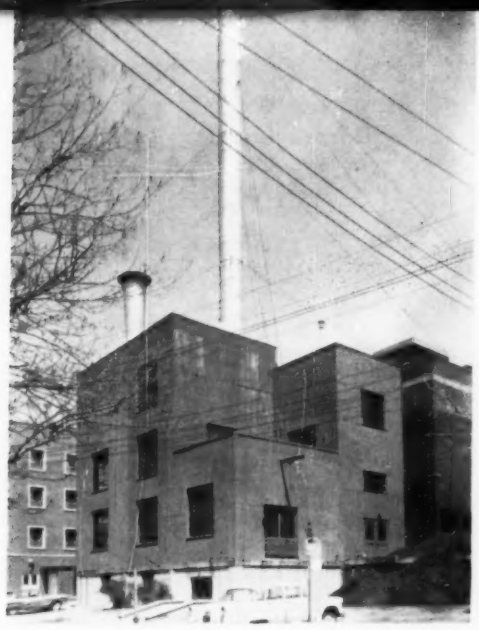
The stories that occur daily at the engineer's desk are exciting, often dramatic. Priorities are assigned, so that hospitals, water works and other important public institutions get first call. But industry of all kinds is served quickly. Fast service is in the NISA tradition.

One of the reasons that the NISA tradition is so strong is the close contact members have with one another. There are 40 city, state and regional divisions of the association. Called chapters, these groups meet regularly, many monthly. Attendance at these meetings — which may last for two days — runs as high as 300 persons. A program of talks of a technical and business nature is the main feature of the meeting. Open discussions of ways and means to serve customers better follow the talks. Manufacturers of motors, varnish and magnet wire, and suppliers of repair shop equipment are usually associate (non-voting) members of these chapters and are encouraged to attend meetings and take part in the discussions.

Once a year, NISA holds an annual convention. Last May more than 1100 crowded into the Hotel Roosevelt in New Orleans for NISA's 25th anniversary convention. There were 12 major talks by leaders in all phases of the electrical industry. There were eight discussion groups on motors, transformers, insulation, sales and advertising. There were more than 50 exhibits of products and supplies. In brief, the event was a valuable four days' education for the many shop owners and their employes who attended, sending them home to do a better job for their customers.

NISA members are encouraged to feature the association's emblem on their stationery and advertising. Many NISA shops schedule joint advertising in the classified telephone yellow pages and other media. Directory of NISA shops is available from the association's headquarters at 818 Olive St., St. Louis 1, Missouri, for $5. Headquarters office will furnish names of shops in any city without charge.

This then is the NISA Network, a made-to-order system to assure buyers of electrical repairs that they are getting the best, most up-to-date kind of service from their independent shop. We believe that industry in general has found the independent shop the best, most economical and efficient source of service. THE END



DePauw Beats Costs In Remodeling Plant

Lacking the benefit of tax support and with only private endowment funds available, major repairs alone can pose a serious problem for a university. Add a sudden increase in steam demand and you have a problem requiring great ingenuity, as this solution shows

Fig. 1. View of the boiler house after remodeling to accommodate new boiler

By M. ARTHUR PERRY*

DEPAUW UNIVERSITY is composed of the Asbury College of Liberal Arts, the School of Music and the School of Nursing. It is a coeducational institution with a faculty of 169 and an enrollment of more than 2000 students who come from most of the 48 states and many foreign countries. The University is located in Greencastle, Indiana, a city of 8000 situated 40 miles west of Indianapolis.

The physical plant of the University includes 18 academic buildings, six halls of residence, an administration building, a President's residence, a physical maintenance building, a gymnasium, a stadium, a faculty office building and a heating plant all grouped near the center of Greencastle on several tracts of land covering more than 60 acres.

Twenty miles west, bituminous coal mines are located near Brazil, Indiana from which coal is delivered daily by truck. This coal has a high Btu analysis and burning qualities which are excellent for our boilers. Cost is $5.50 per ton delivered in the University bunkers.

Fly Ash a Problem

Heating plant is located in what will, in the future, be the center of the campus. We have many close neighbors, and for this reason soot and fly ash must be exceedingly well controlled.

The University is supported entirely by private endowment and contributions. There are no State connections providing tax funds for our numerous operations, hence the need for strict economy.

My first introduction to the heating plant was in the Fall of 1941 prior to World War II. The grates in the Vogt Boiler No. 2 were half broken and the operators were using sheets of paper from catalogues to stop the coal from going through to the ash pit. Lines in the heat tunnels had pulled loose from their hangers and were sagging to the floor in many places. As new buildings had been added to the plant, the required steam lines evidently had been run to the nearest existing pipe fitting and connected. In some cases as much as 200 ft of extra pipe would be involved. For the entire campus this amounted to several hundred feet of superfluous pipe, most of which was improperly sized to meet design conditions.

A Heroic Job of "Make-Do"

Traps all over the campus needed repair. New buckets, thermostatic elements and seats were needed. Gaskets and packings were old and required replacement.

A system for chemical treatment of make-up water had been installed, but one member of the Board of Trustees wanted no part of this. He feared an explosion, and if this did not occur he was certain the entire system would be chemically consumed in a matter of months.

After checking gages, it was found that we had practically no vacuum in the return system. Actually, the return water was pushed back to the plant by steam pressure, consequently the vacuum pumps did not function properly. Boiler drums showed signs of oxygen attack. Nipples at the ends of lines showed signs of carbonic acid attack. Boilers were gorging themselves on coal consumed at the rate of 6300 tons per year. The picture looked extremely discouraging. Then came Pearl Harbor and World War II. In a few months we had Navy Units on the campus. During the war years we had a terrific job just "holding the line" as far as the heating plant was then concerned.

Early in 1948 it was decided to remodel the entire system. It would have to be done over a period of years in order to maintain yearly costs in proper perspective. The main functions of the University must not be upset by too much expenditure in any one department. Accordingly, we made and adopted the following work schedule for the rebuilding of the whole heating system. Time for completion was not definite. We expected it to take at least eight years.

1. Remove chain grates in No. 2 Vogt Boiler. Lower steel structure to permit proper tension on grates. Replace rods and install new grates. Adjust tension and allow for proper expansion.
2. Install new stainless steel skimmers in boiler drums for continuous blow-down control.
3. Redesign valves in continuous blow-down system to allow the jelly-like materials in waste water to pass through system.
4. Check zeolite water softener. Change automatic recharging device to hand operation.
5. Have comprehensive water analysis made and design chemical treatment to remove carbonate scale and give protection from oxygen in all steam and return lines.
6. Set up proper equipment for making daily chemical analyses of boiler water and condensate.
7. Redesign breeching from No. 1 Babcock and Wilcox boiler to give greater natural draft.
8. Build new 179-ft steel smoke stack, wire-guyed to anchors in the ground.
9. Overhaul all reducing valves in the system. Practically all are wire drawn.
10. Overhaul all master traps and

* Superintendent of Buildings and Grounds, DePauw University

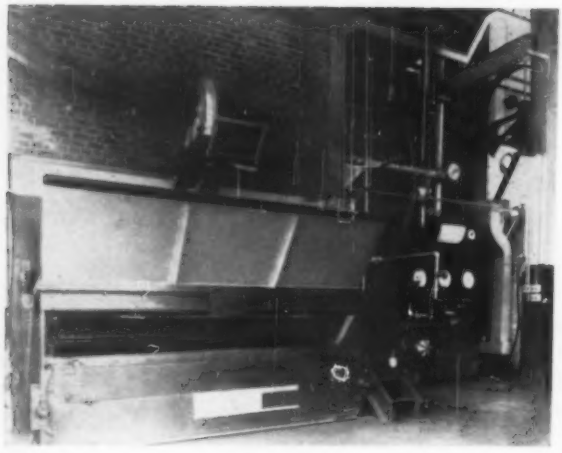


Fig. 2. New stoker arrangement. Control panel in background

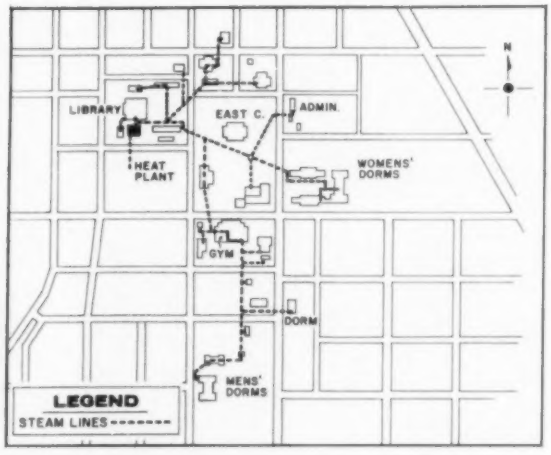


Fig. 3. Plot plan showing master steam distribution system

end-of-line traps. It was necessary in our case to remove old carbonate sludge from all traps. This had been loosened in our lines by the chemical treatment. We also found it necessary to blow down our boilers three times daily in order to remove excess sludge from them.

11. Install new seats and elements in all radiator return traps.

12. Re-disk or install new valves on all radiators.

13. Install new thermometers and gages in all steam heating equipment to check temperatures, pressures, vacuum and so forth.

14. Replace all old steam and vacuum return lines throughout the system.

15. Check and rebuild all expansion joints.

16. Set up system for replacing leaking pipe by cutting out faulty sections and welding in replacement sections. Over a period of years practically all threaded and defective pipe will be eliminated.

17. Design and install a series of air intakes in the tunnel connecting the gymnasium and Florence Hall and revamp circulating fan and controls in order to use heat radiated from steam pipes in the tunnel to heat the gymnasium.

18. Plant had large central vacuum pumps as well as several small return line pumps in the condensate system. All required rebuilding and relocation within the system for optimum operation.

19. Redesign and overhaul all automatic heating controls to fit the needs of the various buildings. Some buildings were still on hand control, much to the disgust of the professors unlucky enough to be in those locations. Over a period of years we expect to eliminate all hand controls.

20. Install new pressure-reducing valves in all branches of the steam mains. Install a new master reducing valve at the boiler plant. Branch valves were to be the weighted-lever-arm type and by the proper setting of these valves it will be possible to carry any required pressure to any of the individual branches.

The Schedule Pays Off

All heat line, building and trap repairs were carried out by our plumbing department. Everyone concerned with this project did just a little more than was required in the strict line of duty. As the work listed on the schedule progressed, we were gratified to find our steam capacity increased and our coal costs reduced.

We added a new union building, greenhouse, seven quonset huts and two residences. In extremely cold weather it was necessary to fire both boilers to the utmost to provide sufficient steam. Since we feared the spectre of one of our boilers failing in such a period, we began to think about additional steam capacity.

A study of the preliminary plans for a new library building convinced us that it would be necessary to add an additional 50,000 lb per hr of steaming capacity to our system.

In view of this need, we investigated packaged units to run in tandem with our existing boilers. This operation did not appeal to our personnel. The cost of a new chain-grate Stirling-type water-tube boiler was deemed to be outside our economic capability. Meanwhile, the library was under construction and the need for additional capacity was pressuring us daily.

One day a sales engineer for a chemical corporation came into our office and asked whether we would be interested in a good used boiler. Somewhat skeptically, we agreed to look at it. Subsequent inspection of this boiler, which was located in the power plant of an abandoned coal mine in Terre Haute, revealed it to be just what we needed. It was a Babcock & Wilcox unit complete with B & W chain grates, controlled by Bailey Meter air controls. Included in the purchase were several thousand dollars worth of spare parts, steel stairs and six Herman Nelson heating units. The boiler had seen only two years service and had received wonderful care from the mine engineer. The purchase price was $11,000.

Savings From Salvage

We secured the services of J. M. Rotz, consulting engineers in Indianapolis and started removal of the boiler. It was completely dismantled and trucked to our site. The fire brick and refractory were originally set in fire clay, thus enabling us to save all the baffles and most of the brick.

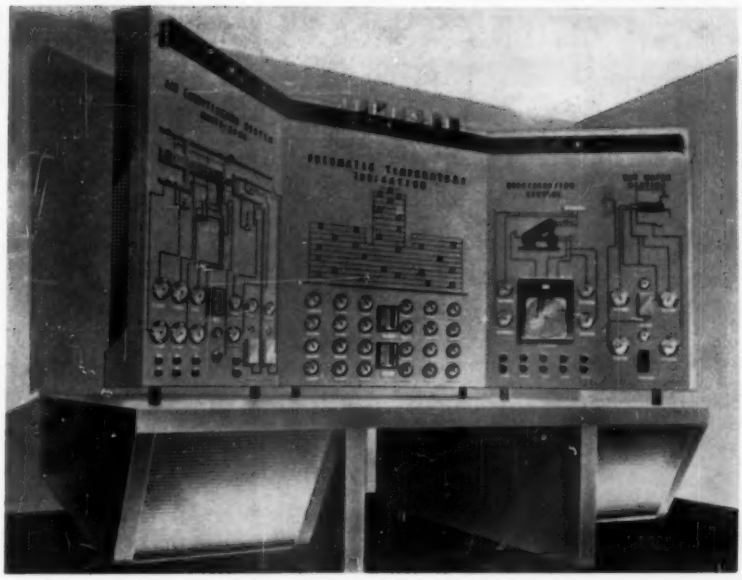
Due to smoke and fly ash, we decided to connect breeching from the new boiler to our tall stack. This arrangement has proved most satisfactory after our first year of operation and our neighbors are satisfied.

The superheater was removed from the boiler and a new series of generating tubes designed in its place. No other design features were added. It was also necessary to increase the size of the building to accommodate the unit. In some areas it was necessary to carry footings twenty ft below the ground. All footings were set on hard pan and clay, and to date we have had absolutely no settlement.

The boiler was erected and refractory set by local contracting firms. Constant and effective supervision was given to the erection at all times by our chief operating engineer, Weldon Stone. Additional services were rendered by Babcock & Wilcox.

Complete remodeling costs including erection of the new building, erection of the boiler and breeching and all repairs as listed under the schedule were approximately $200,000. This figure may seem very low. We have cut many construction corners, but never at the expense of good design or operating efficiency. This is the way that private educational institutions must operate in order to exist during periods of ever-recurring inflation. THE END

Control centers placed in lobbies of public buildings add glamor. Embossed layout explains how system works



Last month the author discussed the swing to miniature controls in heating, air conditioning and combustion. Here he gets down to specifics as he tells how miniaturization of controls relates to . . .

Trends in Central Control Systems

By ARTHUR E. SPAET *

ONE DEVELOPMENT which serves to lend a touch of glamour as well as increased utility, has been the development of centralized control centers, from which over-all temperature readings can be taken and adjustments made in the settings of operating devices, thermostats and the like, located at remote points in the building.

Control centers are not new. Remote reading multi-point thermometers and centralized gage boards have been in existence since the very earliest days of instrumentation technique. However, the addition of a brightly colored, embossed diagrammatic layout of the air conditioning and ventilating systems for a building, with start-stop switches, pilot lights to indicate on-off operation, and temperature control and adjustment devices, all located on a well-lighted and brightly colored graphic display panel, have added a touch of eye appeal to this type of equipment. Such panels have been located in several recent office buildings and hospital installations, in lobbies or other public spaces where they can be seen by the general public and serve as focal points of attention.

The concept of a Data Control Center visible to the public is in keeping with the recent trend towards bringing the mechanical plant out of the concealment of the cellar and making it a public feature, rather than purely functional and hidden. Outstanding in this regard is the glass-windowed and brightly painted refrigeration plant and boiler room at the new Idlewild International Airport, designed by Skidmore, Owings & Merrill, Architects, and Seelye, Stevenson, Value & Knecht, Engineers. Another example is the eye-catching treatment of the water storage towers by the firm of Eero Saarinen at the new General Motors Technical Center, where the water tower was treated as an element of beauty rather than as an item of purely functional equipment.

Concealment of Thermostats

There has developed in recent years a growing disinclination to accept the random occurrence of a thermostat that is completely out of context with the rest of the decorating scheme. In the past, the decorator, after exerting much creative effort in the selection of furniture, accessories, woods, finishes, and wall coloring, was then forced to accept a mechanical looking metallic mesh and wire enclosed box on the wall which might completely destroy the clean effect of his best decorating thinking.

I have seen installations where, in the interests of maintaining the integrity and quality of the interior decor, a carefully selected and framed oil painting was purchased and located over a thermostat in order to eliminate what was considered an intruding eyesore.

There are several approaches to this dilemma. One is to eliminate a thermostat from any finished interior room altogether. It may be possible to locate the room thermostat nearby in the return duct, or possibly nearby in a branch return duct in the machine room, or at the air conditioning fan. A word of caution: the best place for a thermostat is in the room to be controlled. Remote location of thermostats must be carefully engineered; otherwise serious control problems can result. A second possibility is to have the engineer give thought during the engineering and design period to the decorative effect of the thermostat. With this in mind, we have designed recessed thermostat installations with the thermostat located behind a flush decorative wall plate. A concealed recessed air passage permits convection of room air over the thermostat. This requires a considerable degree of combined technical and artistic skill, and complete cooperation between interior designer and air conditioning engineer; it also can provide certain engineering complications. However, it can be done. A third possible technique is to aspirate air with a small fan through a sampling tube, in order to permit locating the thermostat remotely. It is an accepted fact that it is difficult at best to find an ideal average sensitive location for a thermostat in a room where it will not be affected by sun, draft, or supply air outlets or radiators. Therefore, the number of possible locations for a thermostat within a room is limited. Aspirating room air through a sampling tube thus permits the thermostat to be located remotely in a closet, behind a coat rack, or in any convenient loca-

* Slocum & Fuller, Consulting Engineers

tion. Small tube-axial type fans such as are used for cooling of electronic equipment make feasible this method of sampling air.

High Velocity Systems

Problems caused by the advent of the new high velocity, high pressure conditioning systems have brought about a series of interesting innovations and new techniques. Among these are mixing-attenuating boxes which serve to reduce the high pressure in the main trunk ducts to more conventional pressures, in the order of a fraction of an inch of water gage, so that the air may be introduced into the room noiselessly and at conventional low velocities. Special linings and baffled passages assist in eliminating hissing or rushing air noises on the low pressure side leading into the conditioned rooms. Mixing valves of various kinds mix warm and chilled air from dual-duct systems in controlled proportions. Such boxes are available in units suitable for installation under the window, or in the hung ceilings.

A new trend is the assumption of over-all responsibility by the distribution device specialist manufacturer for control of noise, and the quantity and proper distribution of the conditioned air. This specialist manufacturer designs the box, tests and rates its performance, and applies the necessary automatic control equipment.

A more refined approach, which will likely become the accepted method of air quantity control, is to provide constant volume regulation at each individual outlet in contrast to the previous technique of central or bulk air volume control.

A word of caution to the uninitiated. These mixing and attenuating boxes often take up surprisingly large amounts of room, and must be carefully worked into the available spaces. It has been necessary in some cases to provide separate service rooms just to locate some of the larger mixing boxes.

Another recent development connected with the use of high pressure high velocity systems is circular, flexible, plastic or metal foil reinforced air tubing from 3 in. to 6 in. in diam. This type of duct permits much freedom and flexibility in locating and relocating diffusers on the job, and also facilitates connections around columns or beams, or between lighting fixtures. THE END

Clever Way to Sink a Pumphouse Foundation

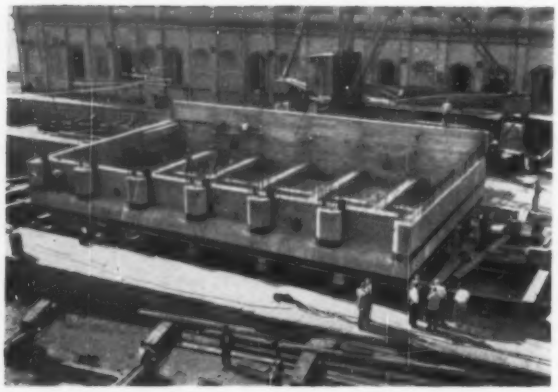
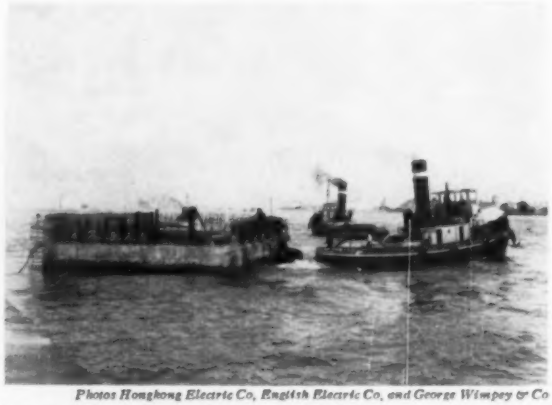


Fig. 1. Space situation was critical, so concrete foundation structure for new cooling water pumphouse was built on slipway across the bay from its Hongkong site. Here is the foundation box ready for launching. Draught is 4 ft



Photos Hongkong Electric Co, English Electric Co, and George Wimpey & Co

Fig. 2. Tugs tow foundation to waterfront site, for sinking into place. Pumphouse is to house five sets of cooling water pumps, each for a new 30-mw steam plant which will enlarge a station owned by China Power & Light Co of Hongkong

Fig. 3. Positioned foundation is sunk into place. Draught is now 9 ft 9 in. Fill was added to anchor the box permanently. When anchoring was completed, and weight added, water was pumped out of the flooded basin, and here is . . . . .

Fig. 4. Nice, sunken basin, with building structure added ready to receive pumps. No divers, no underwater construction, no trouble—oh, yes, correction: divers were used to level out box after it was in place, but there was no trouble

CONSTRUCTION NEWS

Alexander City, Ala. — Light & Water Department, City Hall, plans expansion in municipal power plant, with installation of new substation and reworking of electrical feeder lines. Work will begin at once for completion late in 1959 at a reported cost of approximately $500,000.

San Francisco, Calif. — Pacific Gas & Electric Co, 245 Market St, has announced plans for the construction of new power plant at Big Sulphur Creek, in Sonoma and Lake Counties. Plant will have an initial capacity of 12,500 kw and will utilize steam from geysers near Big Sulphur Creek. Work will proceed at once for completion in early 1960. Plant will represent a capital outlay of $2,000,000.

Rangely, Colo. — Moon Lake Electrical Association, Vernal, Utah, has authorized plans for the construction of new power plant on large building site recently acquired. Plans call for the installation of two new diesel-generating units and auxiliary equipment. Work to begin at once will also include large one story structure of steel and concrete construction to house the new units, as well as, substations, wiring, switch-gear and transmission lines. Work when completed in late 1959 will represent an investment of approximately $1,350,000. A. C. Kirkwood & Associates, Kansas City, Mo., is the consulting engineer of the project.

Idaho Falls, Idaho — Atomic Energy Commission, 1901 Constitution Ave, N. W., Washington, D. C., has announced contract award to the Fluor Corp, Ltd, Los Angeles, Calif., for the construction of new plant to calcine and treat highly radioactive liquids produced in the recovery of fissionable materials from spent fuel elements at the National Reactor Testing Station, near here. Work on the new facility will begin at once for scheduled completion by early 1960. The project will cost an estimated $3,000,000 when completed.

Marshalltown, Iowa — Iowa Electric Light & Power Co, Security Building, Cedar Rapids, Iowa, has announced contract award to the Babcock & Wilcox Co, Boiler Division, New York City, for the installation of steam-generating equipment at company's Sutherland Station, now under construction, near here. Work to begin in two or three months, will include installation of high-pressure boilers and auxiliary equipment, reported to cost approximately $3,000,000. Plant is scheduled to go into operation sometime late in 1960.

Minneapolis, Minn. — Minneapolis-St. Paul Metropolitan Airports Commission, 2429 University Ave, St. Paul, Minn., has announced plans for the construction of a large new engine building, boiler plant and auxiliary equipment and water reservoir including stores and shop buildings at Northwest Airlines main base at World-Chamberlain field located here. F. R. Comb Co., Minneapolis, Minn., is general contractor. Work reported to cost in excess of $2,950,000, is already under way and scheduled for completion early in 1960.

Collins, Miss. — South Mississippi Electric Power Association, has approved plans for major improvements to company's system, including installation of new power generating unit, and extensions and improvements to company's transmission lines. Work will begin at once for scheduled completion by spring of 1960. Work when completed reported to cost $1,397,000.

Montrose, Mo. — Kansas City Power & Light Co, 1330 Baltimore Ave, Kansas City, Mo., has authorized plans for major expansion of power plant here. Plans call for the installation of a new steam-electric generating unit with an initial capacity of 175,000 kw, high-pressure boilers and auxiliary equipment. Work will begin soon on the expansion project scheduled to go into service by the summer of 1960. Company has recently expanded its kilowatt capacity by placing in service a similar unit, bringing total capacity of the plant to 816,000 kw. New work is part of a planned 1958–1961 capital expenditure of $105,000,000.

Annandale, N. J. — State of New Jersey, Director of the Division of Purchases and Property, State House, Trenton, N. J., has plans under way for the replacement of boiler plant and auxiliary equipment at State Reformatory here. Work will get under way at once for completion by mid-1959. No estimate of cost announced.

Asbury Park, N. J. — Jersey Central Power & Light Co, 501 Grand Ave, this city, has made application to the Public Utilities Commission for approval of the purchase by Jersey Central Power & Light Co, of Tri-County Rural Electric Co, Inc, of Manalapan, at an agreed purchase price of $917,000. Company has agreed to pay all outstanding debts of Tri-County when sale is completed. Stockholders of Tri-County Rural Electric Co, Inc, have already approved the sale of the company. Formerly, a cooperative operating unit of the FREA, Tri-County purchased power from Jersey Central Power & Light Co, for distribution through its own system to its 2350 customers in sections of Monmouth, Ocean, Middlesex and Burlington Counties.

Buffalo, N. Y. — The National Science Foundation, 1520 H St, N. W., Washington, D. C., has authorized a $425,000 grant to the University of Buffalo, this city, for the construction of a small nuclear reactor on the university campus. Work is expected to get under way on the new 100 kw reactor in about 30 days and is scheduled to go into operation early in 1960. Local industry and the National Institutes of Health, 9000 Wisconsin Av, Bethesda, Md., will contribute the balance of the initial cost reported to be about $1,050,000.

New York, N. Y. — Consolidated Edison Co, of New York, Inc, 4 Irving Place, has announced completion of an additional steam-electric generating unit at company's Astoria Power Station in Queens, N. Y. The new unit, with an initial capacity of 335,000 kw., known as Astoria No. 3, raises the combined power generation capacity of Consolidated Edison's nine generating stations to more than 4,000,000 kilowatts.

Davidson, N. C. — Duke Power Co, 422 S Church St, Charlotte, N. C., has announced that the company has been granted by the FPC, a 50 year license for its Catawba-Wateree hydroelectric power project located on the Catawba River, just west of here. Development, to be known as the Cowan's Ford Power Project, will have an ultimate generating capacity of 35,000 kw. Work will include construction of a 5870 ft concrete and earth fill dam backing up a 29,760 acre reservoir. Project when completed in early 1961 will represent a very large capital outlay for the company.

Norwalk, O. — City of Norwalk, City Hall, has approved plans for the modernization of municipal power plant. Work to include installation of new turbine generator unit is part of a general expansion program, including power substations, transmission lines and other facilities. Cost of project reported to be about $2,200,000, under supervision of Alden E. Stilson & Associates, Columbus, O., engineers.

Kingston, R. I. — State of Rhode Island, State House, Providence, has authorized plans for major additions and improvements to electrical distribution system at the University of Rhode Island, located here. Coken Co, Providence, R. I., will be in charge of construction of the new improvement reported to cost approximately $143,000.

Burlington, Vt. — Municipal Light Department, City Hall, has plans under consideration for the construction of new nuclear power plant reported to represent an investment of $22,000,000. J. F. Pritchard & Co., Kansas City, Mo., and Westinghouse Electric Corp, Pittsburgh, Pa., are consulting engineers of the project which will get under way soon.

Richland, Wash. — The Atomic Energy Commission, 1901 Constitution Ave, N. W., has announced that final plans have been completed for the construction of a big new atomic reactor to produce plutonium, the raw material used in the construction of atomic weapons. General Electric Co, Schenectady, N. Y., has been assigned final engineering design of the reactor to be located at A.E.C.'s Hanford Works, located here. Construction of the new unit will begin in the spring of 1959 for completion in the early part of 1963. Congress has already authorized the monies necessary for the $145,000,000 reactor to step up the nation's plutonium producing capacity.

Power Engineering handbook

Introduction to Steam Power

8—Feedwater Treatment

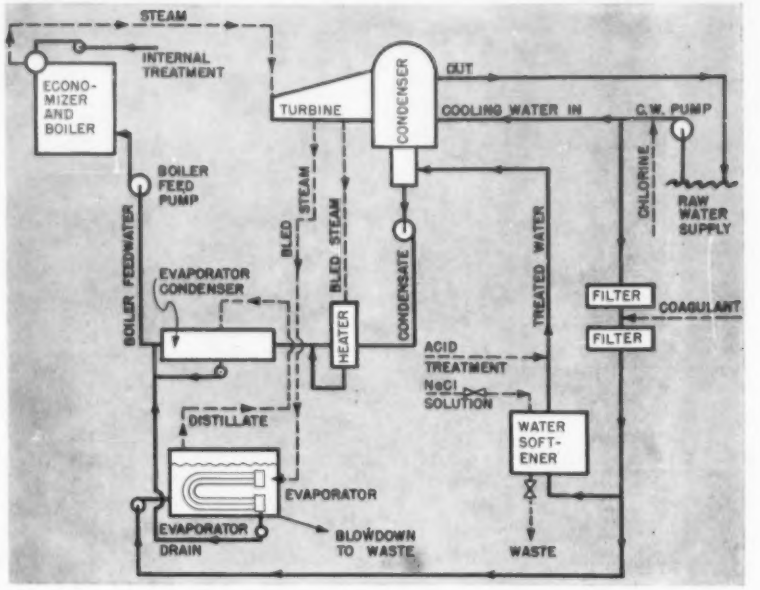
This discussion brings to a close the course on steam power fundamentals developed by Commonwealth Edison Co of Chicago for after-hours educational use and serialized in this department beginning in May, 1958. The course was authored by the following Commonwealth Edison engineers: R. A. Dannells, F. W. Beeman, the late J. R. Bonnell, and J. B. Burkhardt.

Practical Methods of Treating Feedwater

1. Sedimentation, Coagulation, Filtering
   a. Since water from city water mains is used for make-up in the feedwater cycle these methods are no longer used.
2. Sodium Zeolite Treatment
   a. Process in which water is filtered through a material that appears to be a green sand.
   b. Sodium (Na) of the zeolite replaces the calcium and magnesium of the water.
   c. Zeolite can absorb only a definite amount of the calcium and magnesium.
   d. Softener is regenerated by washing zeolite with brine (NaCl) solution and rinsing to remove excess salt. Sodium chloride + calcium zeolite = calcium chloride + sodium zeolite.
   e. Dissolved solids have not been removed, only changed in form: 1. Treatment is generally preceded by filtering with coagulation. 2. Method results in high alkalinity water, usually followed by treatment with sulfuric acid.
3. Hydrogen Zeolite (Zeo-Karb H) Treatment
   a. Hydrogen zeolite is a non-siliceous organic material that has the property, when operated in the acid cycle, to exchange hydrogen for cations such as calcium, magnesium, sodium.
   b. The bicarbonate, sulfate, nitrate and chloride radicals are converted to their respective acids. Example: $Ca(HCO_3) + H_2Z + CaZ + 2\ H_2CO_3$
   c. Carbonic acid formed is removed by degasification; all other acids formed in exchange must be neutralized with caustic soda.
   d. When the hydrogen zeolite becomes exhausted it is backwashed and regenerated with sulfuric acid.

Republication rights reserved by Commonwealth Edison Co

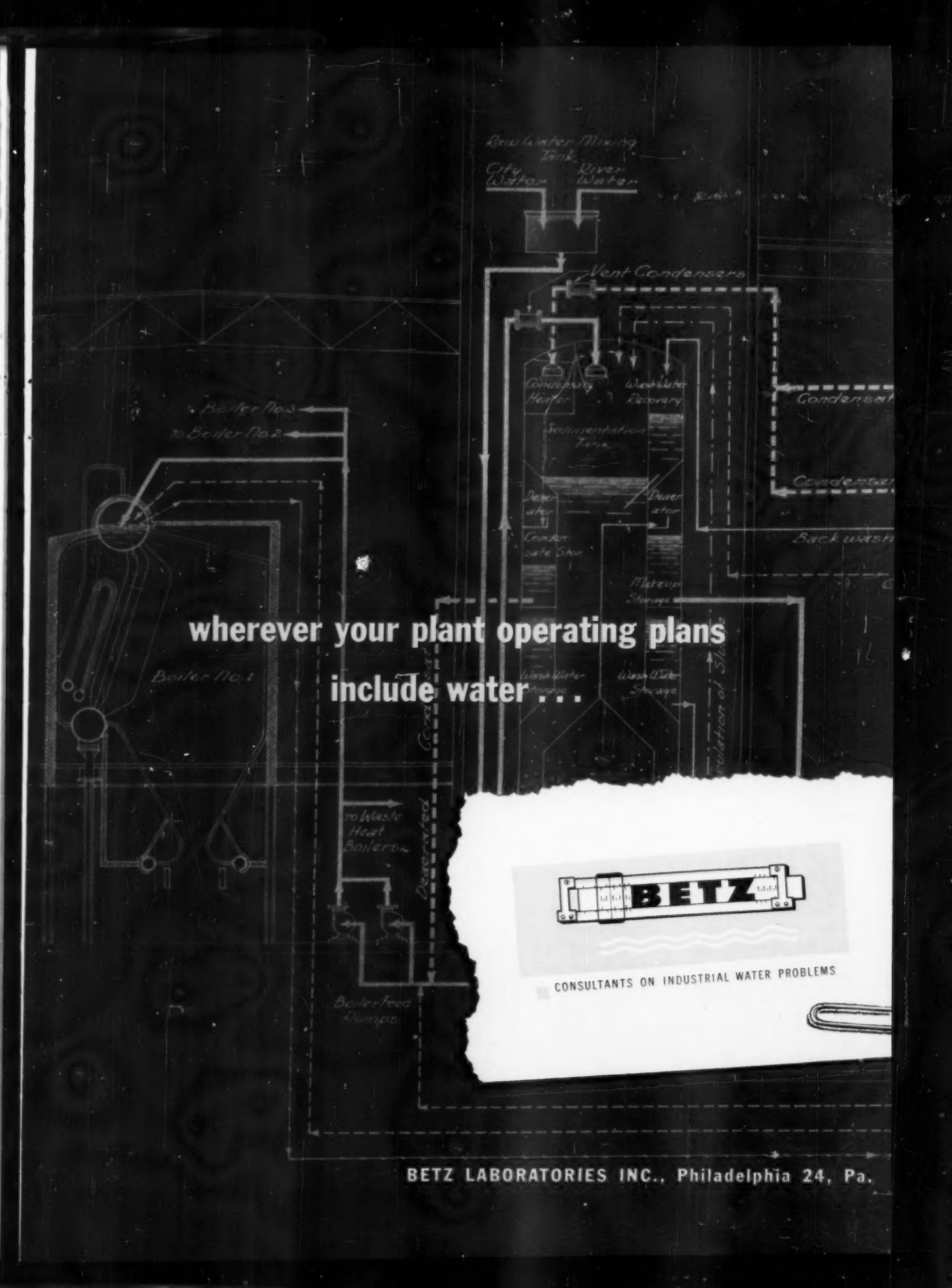
fold along this line—outside edges toward you



This is typical flow diagram for combined evaporation and softening treatments

   e. *Advantages:* 1. Completely eliminates hard scale-forming salts. 2. Removes bicarbonate alkalinity without substituting other salts in its place — possible actually to reduce total solids content. Makes good evaporator feed. 3. No pick-up of silica.
4. Demineralization Treatment
   a. Permutit "S" unit is added to the hydrogen zeolite treatment unit.
   b. Active material in the "S" is a synthetic amine-type resin which has the property to exchange hydroxylions (OH) for the bicarbonate, sulfate, nitrate, and chloride radicals of the acids in the effluent from the hydrogen zeolite unit.
   c. When the "S" unit bed is exhausted it is regenerated with sodium hydroxide.
   d. *Advantages:* 1. Effluent as good as evaporated make-up, thus eliminating evaporator; may be introduced into feedwater cycle directly. 2. Rate of increasing storage make-up not dependent on turbine operation and load.
5. Evaporation Method
   a. This method consists of evaporating the raw water and condensing the pure vapor which is used as feedwater.
   b. The heat for evaporating the water is furnished by "live" or bled steam.
   c. All of the heat from the vapor is utilized in the turbine cycle. Condensate from the turbine condenser is used as cooling water for the evaporator condenser — thus the latent heat of the distilled water is returned to the feedwater.
   d. The evaporator removes all types of impurities: A. Scale deposits on tube surfaces and is released by "cracking." 2. Scale

cut along this line


Raw Water Mixing Tank
City Water
River Water
Vent Condensers
Condensate Heater
Waste Water Recovery
Sedimentation Tank
Deaerator
Condensate Stor.
Makeup Storage
Backwash
Boiler No.3
Boiler No.2
Boiler No.1
to Waste Heat Boilers
Deaerated
Boiler Feed Pumps
wherever your plant operating plans include water . . .
BETZ
CONSULTANTS ON INDUSTRIAL WATER PROBLEMS
BETZ LABORATORIES INC., Philadelphia 24, Pa.

and other solids, both suspended and dissolved, are removed by "blowing down." 3. Gases are removed by venting. Sodium sulphite (Na_2SO_3) may be added to the raw water to absorb dissolved oxygen. 4. Steam cleaning devices are provided to reduce carry-over from the evaporator.

6. Deaerators, Degasifiers, and CO_2 Boilers
   a. Ability of water to hold dissolved gases decreases with increased temperature.
   b. Water is sprayed or "rained" through steam.
   c. Released gases are vented to atmosphere or heat exchangers.
   d. Gases removed: 1. carbon dioxide, CO_2; oxygen, O_2; ammonia, NH_3.
7. Internal Boiler Water Treatments
   a. Internal treatments are necessary: 1. to supplement external treatments; 2. because of impurities introduced by condenser leakage.
   b. Use of phosphates: Phosphates react with calcium compounds to form tricalcium phosphate, a non-settling, insoluble sludge

$$3CaCO_3 + 2Na_3PO_4 \longrightarrow Ca_3(PO_4)_2 + 3Na_2CO_3$$

$$3CaSO_4 + 2Na_3PO_4 \longrightarrow Ca_3(PO_4)_2 + 3Na_2SO_4$$

   Resulting compounds are non-scale forming.
   c. Use of "Santosite," sodium sulphite: Sodium sulphite combines with dissolved oxygen to form sodium sulphate.

$$2Na_2SO_3 + O_2 \longrightarrow 2Na_2SO_4$$

   Theoretically it requires 7.875 lb of chemically pure sodium sulphite to absorb 1 lb of oxygen.

Reduction of Carry-Over

1. Carry-over increases in general with: a. increased steaming rate of boiler; b. increased entrained moisture content of steam leaving drum; c. increased boiler water solids concentration.
2. Steam scrubbers or washers reduce the solids concentration of entrained moisture.
3. Eliminators, separators, or dryers reduce the moisture content of steam.
4. Blowdown reduces the solids concentration of the boiler water: a. blowdown creates heat and water losses; b. heat may be recovered with heat exchangers.

Field Tests to Control Boiler Water

1. Dissolved oxygen.
2. Boiler water solids concentration.
3. Condenser leakage.
4. Hydroxide in feedwater.
5. Residual phosphate in boiler water.
6. pH of hydrogen ion concentration.
7. Santosite residual in boiler water.

Limitations for Water Conditions

1. General Considerations
   a. Feedwater and boiler water requirements are dependent upon the particular installation, as regards: 1. steam pressure, temperature; 2. rapidity of circulation in boiler; 3. efficiency of steam cleaning devices; 4. rating at which boiler is operated.
   b. Choice of make-up treatment dependent on: 1. quantity required for make-up; 2. type of make-up water available; 3. use of evaporators dependent on heat cycle of station.
2. Boiler Water Conditions: For High Pressure Conditions
   a. Total solids — less than 650 ppm.
   b. pH — from 10.5 to 11.
   c. Phosphate residual — from 10 to 50 ppm.
   d. Santosite residual — from 5 to 20 ppm.
   e. Silica residual — less than 3 ppm.
3. Boiler Feedwater
   a. Dissolved oxygen, zero in all cases.
   b. Hardness, zero for higher pressure.
   c. Chlorides, low as possible — not over 6 ppm expressed as chlorine.
   d. Oil, none.
   e. Total solids — a minimum. Good feedwater for pressures above 1200 psi should contain less than 1.5 ppm.
   f. Suspended solids, none.
   g. pH value, over 8.0 for protection against corrosion of piping, pumps.
   h. Organic matter, as low as possible.

fold along this line—outside edges toward you

Taper Cut Helps in Repairing Air Heater Tubes

By O. M. LAMBINE*

IN THE JULY, 1958 ISSUE of POWER ENGINEERING, the Handbook contained an interesting article on the use of repair tubes, or sleeves, for tubular air heaters (page 88). We should like to add a refinement which greatly increases the usefulness of this device.

Our Phillipsdale, R. I., plant has made effective use of these sleeves, or tube inserts, for the past six years. But we found that in cases where the tubes had corroded off, the broken ends would invariably shift out of alignment and many times it was impossible to insert the repair tube, making it necessary to plug the defective tube.

To overcome this difficulty, a simple but extremely effective modification was worked out by chief engineer E. E. Peterson. Instead of cutting the repair tube off squarely, he cuts it on a long bevel (see figure).

*Chief Engineer, Bird & Son, Inc, East Walpole, Mass.

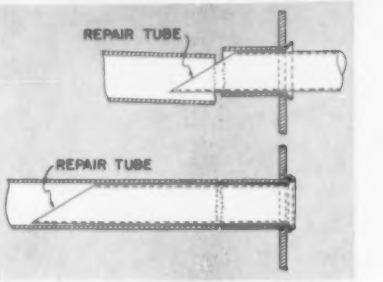


Fig. 1. Tapering end of the insert eases alignment

By means of this taper, broken tube ends only partially in line are easily brought into full alignment. Ordinarily, light tapping is sufficient to seat the insert tube, but in stubborn cases, or where jagged edges interfere, a twist with a pipe wrench will usually do the trick.

Here's a Time-Saver for Electrical Work

THIS DEVICE, called a Jet Line Gun, was invented by experienced electricians to eliminate the need to snake wire through conduit with a fish tape.

The gun releases a gas-filled cylinder which jet-propels itself through the conduit at high speed, laying a light-weight nylon line behind it. This line is used to pull a special polyethylene rope into the conduit, which in turn is used to pull wire.

Runs up to 600 ft are possible in all kinds of conduits and ducts. Average time required per conduit is less than 3 min to set, shoot, and pull in the rope.

Kit contains gun, nylon line, cartridges, and accessories for different types of conduits.

For more information about Jet Line Gun, write the Editor, POWER ENGINEERING, or use postcard in this issue.

Jet Line Gun provides for the laying of a line through conduit by firing a self-propelled cartridge

cut along this line

MEAD-MORRISON

UNLOADING TOWERS

Coal unloading tower built for the River and Gulf Transfer Company on the dock of the Tampa Electric Company, Tampa, Florida.

This tower incorporates the most advanced engineering refinements. A one rope progressive reeving system, hydraulic rail clamps, extendable air conditioned cab, enclosed hopper, jib crane, and dead man control all contribute to make the complete operation easier and more efficient. The patented Mead-Morrison reeving system uses one rope for both the hoisting and closing operations, increasing the rope life of the system more than 300%. The Mead-Morrison hydraulic rail clamps are provided with serrated shoes to grip the rail and do not depend on friction to hold the structure fixed to the rails. For better operator visibility when unloading ships the extendable cab is extremely advantageous. The hopper enclosure confines dust to the hopper area, greatly reducing the amount escaping to the outside.

MANUFACTURING ENGINEERS · McK · ESTABLISHED 1895 ·

McKIERNAN-TERRY CORPORATION

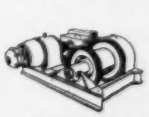
ORE BRIDGES

RAIL CLAMPS

PILE HAMMERS

CAR DUMPERS

GRAB BUCKETS



CAR HAULS

MEAD-MORRISON DIVISION • HARRISON, NEW JERSEY

WESTERN SALES OFFICE: 7 SOUTH DEARBORN STREET, CHICAGO 3, ILLINOIS

For more data circle 547 on Post Card

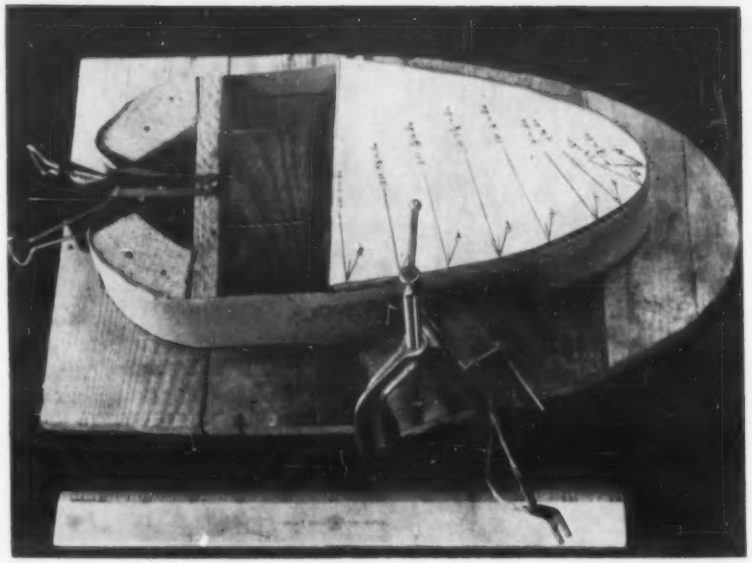


Fig. 1. Home-made device eliminates much of the time-consuming work of sanding in new brushes for commutators and collector rings. Figures 2 and 3 illustrate how device is made by Navy electricians

Simple Device for Beveling, Concaving Brushes

WRITING in the *Bureau of Ships Journal*, V. E. Gardner of the Electrical Branch, Bureau of Ships, describes this simple device (Fig. 1) for beveling and concaving brushes for commutators and collector rings. The Bureau reports that to its knowledge no commercial device is available which performs this function.

Three pieces as shown in Fig. 3 (of 5⅝-in. diameter, 6½-in. length) are cut by a jig or coping saw, from ¾-in. boards and are stacked together to form an assembled part, E, 2¼-in. thick. This is the part E shown in Fig. 2.

The rocker arm, M, shown in Fig. 2 is also made from ¾-in. boards. The rocker arm consists of two sectors, S, which are nailed or glued to a crossbar, CB.

A strong, smooth board approximately 14½ by 9½ by ½-in. is used for the base, F.

A strip of metal, 2¼ in. wide by 17 in. long, which can be cut from a 1-gal. can, is wrapped tightly around part E.

An old, full box brush holder, H, sufficiently large to accommodate a brush at least ½-in. thick and 1½ in. wide, is used to hold the brushes. Some form of shims and spacers will be required for smaller brushes, to prevent rocking in the holder.

A C-clamp, part C of Fig. 2, is used to clamp the brush holder to the base.

One bolt, approximately ¼-in. in diam by 3 in. long, is used to fasten the rocker arm to the base. A washer should be placed between the rocker arm and the base so that the rocker arm will rotate freely.

fold along this line—outside edges toward you

Flint abrasive (sand) paper is used to shape the brushes. A roll 2 in. wide may be used or, instead, sheets may be cut in strips 2 in. wide and fastened together with cellophane tape applied to the smooth side to orm part P in Fig. 2. The back of the abrasive paper will slide smoothly along the metal which is wrapped around part E.

A No. 210 paper binder clip, indicated as part D in Fig. 2, clamps the abrasive paper; and a rubber band N, to be looped around the rocker arm and binder clip, maintains tension in the abrasive paper.

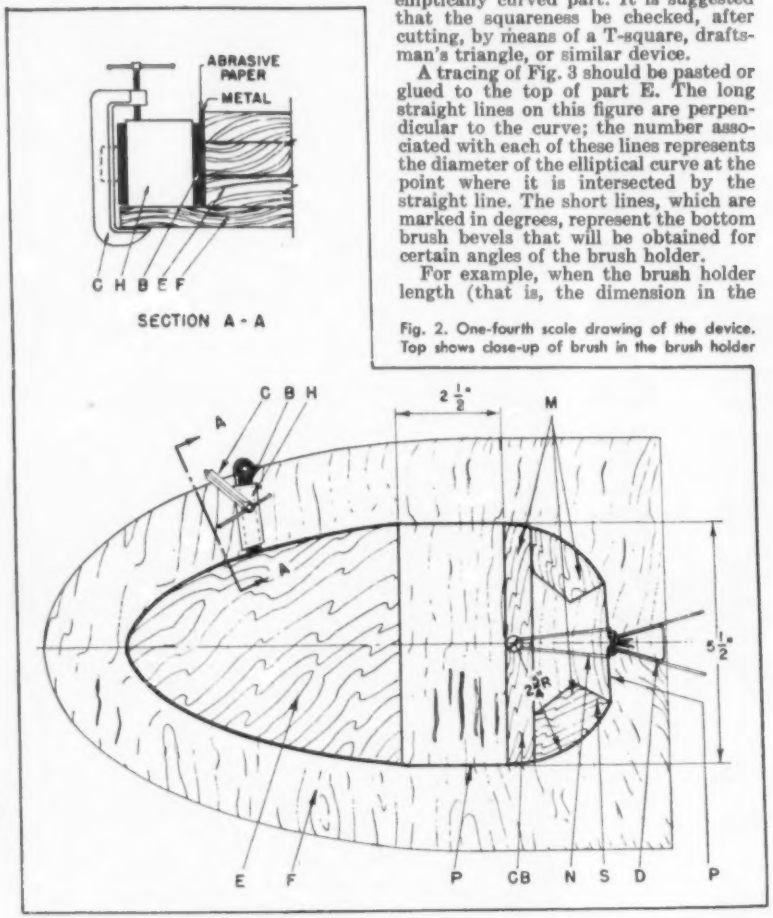


Fig. 2. One-fourth scale drawing of the device. Top shows close-up of brush in the brush holder

Importance of Accuracy

The most important part of the construction is to cut the elliptically curved part with great accuracy. The saw must follow very accurately the outline of Fig. 3, and the blade must be strictly perpendicular to the flat surface of the elliptically curved part. It is suggested that the squareness be checked, after cutting, by means of a T-square, draftsman's triangle, or similar device.

A tracing of Fig. 3 should be pasted or glued to the top of part E. The long straight lines on this figure are perpendicular to the curve; the number associated with each of these lines represents the diameter of the elliptical curve at the point where it is intersected by the straight line. The short lines, which are marked in degrees, represent the bottom brush bevels that will be obtained for certain angles of the brush holder.

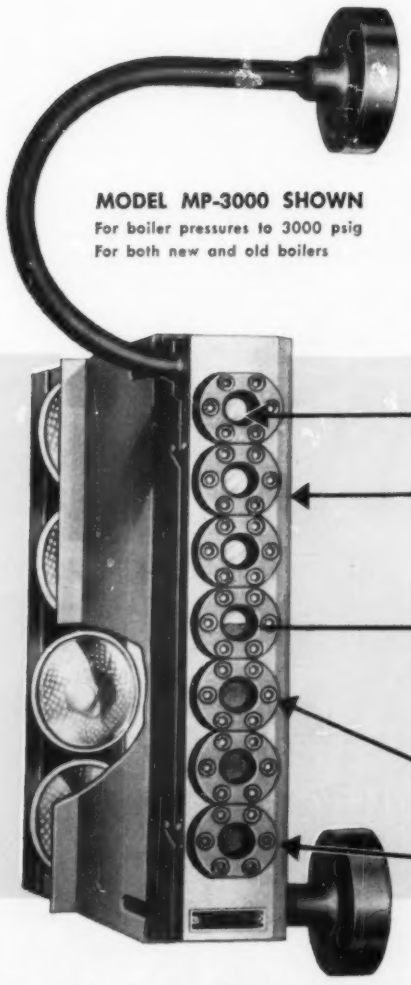
For example, when the brush holder length (that is, the dimension in the

cut along this line

MORE THAN ~~950~~ ~~1400~~ 2000

DIAMOND MULTI-PORT GAUGES

In use and on order for over ~~240~~ ~~300~~ 315 Central Station Generating Plants



MODEL MP-3000 SHOWN
For boiler pressures to 3000 psig
For both new and old boilers

- SMALL ROUND PORTS INSTEAD OF LONG GLASS AND MICA STRIPS
- GAUGE NEVER REMOVED FROM BOILER FOR GASKET CHANGES OR OTHER NORMAL MAINTENANCE
- STEAM SHOWS RED
- WATER SHOWS GREEN
- COMPLETE PORT CHANGE REQUIRES ONLY ABOUT 15 MINUTES
- EACH PORT THERMALLY INDEPENDENT

Also available is Model MP-900 for boiler pressures to 900 psig

Because the Diamond Multi-Port solves the problems inherent in water level gauges on boilers operating at high temperatures and pressures, it has had rapid and wide acceptance. In addition to the 2000 for central station generating plants, more than 185 have been sold to industrial power plants.

Advantages of the Multi-Port are many. In addition to those shown above, it has maximum thermal stability for rapid starting . . . "Hi-Lite" illuminator for improved readability . . . welded construction for permanent tightness . . . end stems can be furnished instead of flanges . . . startling reductions in maintenance costs.

Write for Bulletin 1174 (Model MP-3000) or Bulletin 2044 (Model MP-900) for more information.

8032

Diamond

DIAMOND POWER SPECIALTY CORP.

LANCASTER, OHIO • DIAMOND SPECIALTY LIMITED — *Windsor, Ontario*

For more data circle 548 on Post Card

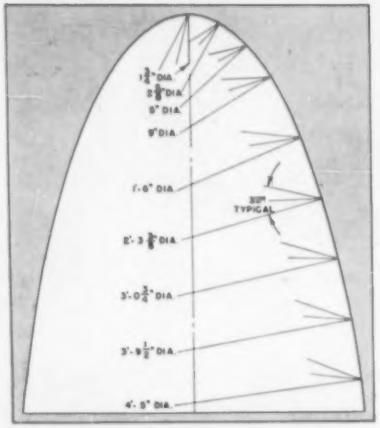


Fig. 3. Plan of the elliptically curved part E of Fig. 2. Diameter is 5⅛ in., length 6½ in.

direction in which the brush feeds to the commutator or collector ring) lines up with the short line marked 30 deg, it means that a bottom level of 30 deg will be obtained. The values of 30 deg and 15 deg were selected for Fig. 3 because 30 deg is a popular bevel for brushes in the leading position and 15 deg is a popular bevel for the trailing position.

To position the brush holder properly, first select the point on the curve at which the diameter corresponds to the diameter of the commutator or collector ring of the machine for which the brush is intended. Then set the length dimension of the brush holder to line up with the short line which is marked with the bevel angle desired. The position of the brush in Fig. 2, for example, is based on a commutator diameter of approximately 2 ft, 4 in. and a brush bevel of 10 deg.

The abrasive paper is moved back and forth under the brush, B, by rocking the rocker arm through a total angle of from 60 to 90 deg. The rocker arm could, of course, be omitted if it is preferred to pull the abrasive paper by hand.

Only one brush holder is shown in Fig. 2, although it is possible, except in the case of brushes intended for the smallest commutators or collector rings, to use two brush holders, one on each side of part E, at the same time.

Benefits

Benefits from the use of this device are listed as three in number:

1. Elimination of much of the time-consuming and tiresome work of sanding in of new brushes on the actual commutator or collector ring of the machine for which the brushes are intended, especially where the bottom level is not of the exact angle required. It is to be emphasized, however, that the use of this device will not eliminate all such sanding in. Some sanding in will still be necessary to assure proper contact. The sandpaper should be moved only in the direction of rotation to obtain the best of contact during the final sanding in.

2. Less carbon dust coming in contact with the windings and commutator or collector ring.

3. Consolidation of stocks. From a stock room viewpoint, it would be preferable to stock brushes with no bottom bevel or concave face.

Jot it down NOW . . . and send it to us

- We mean, of course, that practical idea, tool, method or process that has helped you do a job better, somewhere in the power field.
- For material accepted for POWER ENGINEERING Handbook we pay up to $35—and it doesn't have to be fancy. Just send us the facts, in memo form if you like, with rough sketches, diagrams or snapshots to illustrate what happened. We'll do the rest.

fold along this line—outside edges toward you

Fig. 1. Don't discard those worn-out files! Their fine quality steel is excellent for use as hand scrapers, for bearings, valve slides and seats of pumps, gasket seats, etc. Forge to your favorite shape, harden and temper, grind with care and stone the edges. Here are some transformations that are popular in our shop

Try These Useful Shop Tricks

By CHARLES H. WILLEY

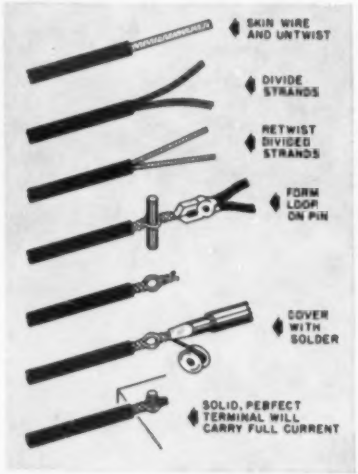


Fig. 2. When you don't have a commercial-type wire terminal on hand to solder onto your lead wire or other line, try this way of making the terminal right on the wire end. It works well

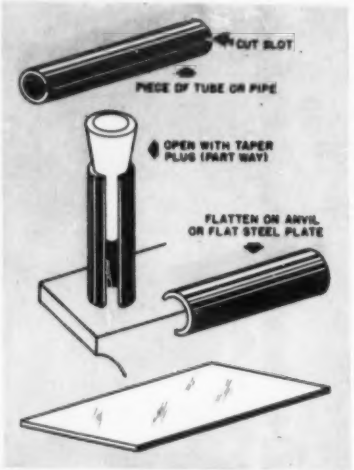


Fig. 3. Need some small flat stock in a hurry? Here's an emergency way of getting a liner, shim or other small part from tubing or pipe. Brass is the best kind of stock to use for solving this problem

cut along this line

Here's a vertical turbine with

TERRY SOLID WHEEL

and all its advantages

When it comes to judging a turbine's ability to deliver in vertical service, ratings tell only half the story. It's the Terry construction refinements that give you assurance of long-range operational economy: Thrust bearing designed to absorb external pump thrusts ... carbon ring glands specially made for vertical operation ... casings and bearing housings split vertically for easy accessibility.

But most important, the Terry vertical turbine has an *almost* indestructible rotor. A single forging of special composition steel, it has no separate parts to loosen or work out. As the only function of the blades is to form a series of pockets, any wear which might occur would not materially affect horsepower or efficiency.

If your application demands a vertical turbine, specify Terry solid wheel. Available in capacities from 5 to 300 horsepower. And remember, the extra durability built into these vertical turbines is typical of every turbine in the complete Terry line.

For further information, send for a copy of bulletin S-137.

THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

TERRY

TT-1210

For more data circle 549 on Post Card

EQUIPMENT NEWS

Reader Service Cards on pages 119–120 make it easy to get further information on any of these products. Just circle the item numbers of the products you want to know more about.

1—ROBOT CHEMIST automates analytical functions

The AutoAnalyzer, a system for continuous automatic chemical analysis, is designed to detect trace materials down to parts per billion, with an accuracy of 1 per cent. By automating each step of a chemical analysis otherwise performed manually — measuring, mixing, purifying, processing, comparing and record-

ing, and integrating them into a continuous flow system — the AutoAnalyzer is reported to provide accurate, dependable analysis with exact reproducibility.

In the laboratory, this robot chemist can run 20 to 60 tests per hour without human supervision, manufacturer points out, and in the plant it can be hooked up to the process or waste stream, liquid or gas. Concentration level of any material or number of materials can be continuously monitored and recorded. If desired, the control loop can be closed to automatically monitor the steady-state control devices or otherwise regulate the process through "on stream" continuous measurement. Systems are available for single or multiple component determinations. Technicon Controls, Inc.

2—TRANSFORMERS AND BREAKERS can use the same bushing

In the TBI (Transformer-Breaker Interchangeable) line of bushings, eight basic bushings cover all applications in standard voltage classes from 23 to 196 kv. As explained by manufacturer, recent ASA standards for outdoor apparatus bushings provide 37 bushings in this range. TBI Bushings are reported to meet ASA standards and provide complete interchangeability as well. To achieve this, design changes in company's power transformers, medium transformers and oil circuit breakers were made, where required, so that bushings with same ground sleeve and length below cover can be used for all apparatus. Also, each TBI Bushing has a dual current rating, 400/1200 amp in the 23- to 69-kv range, and 800/1600 in the 115- to 196-kv range. Current rating is determined by terminal accessories, since in all TBI Bushings the conductor inside the bushing is designed for maximum current. To convert from one application to another, changing terminal accessories is all that is required.

Since the basic difference between transformer and breaker application is current rating (breakers need the higher capacity) the key to interchangeability is the dual current rating, company explains. In all voltage classes the TBI has a hollow conductor. With breakers, the bushing can be connected at the bottom to the breaker interrupter. In transformers, the draw lead can be pulled up as usual through the hollow conductor and connected at top. It is announced that TBI Bushings can be specified for company's power transformers, medium transformers and high voltage circuit breakers next year. Benefits anticipated for utilities are potential saving in spare bushing inventories and faster and better emergency service possible. General Electric Co.

3—TIME SWITCH carries its own reserve power

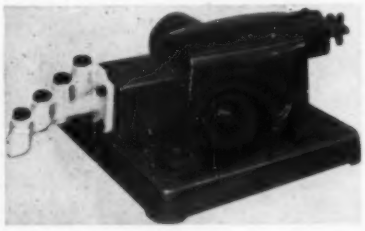
Tork's Reserve requires no winding, maintains "on time" operation during even prolonged "outage" period it is announced, and, in the event of a series of outages in a short span of time will always be "on duty". The device offers safety benefits and savings in time, money and manpower. Reserve action of the control is provided by a powerful spring, electrically wound by the time switch. A release mechanically exercises the spring daily, it is explained, and this regular exercising serves to keep the unit in condition. When power fails, the reserve power takes over and keeps the time switch in operation for up to 17 hr. With power restored, normal a-c operation of the time control is resumed, and at the same time the reserve spring is rewound. Manual rewinding isn't necessary. If the reserve power is used for the full 17-hr. period, it is still rewound in 2 hr, company states, and shorter outage periods require less rewind time. Tork Time Controls, Inc.

4—SPRAY-ON LUBE protects open gears, chains, cams

Acrolite Gear-Lube Spray comes in an aerosol can. You simply push the button and spray the grease on the gears or other surface. This lubricant forms a tacky surface within minutes after spraying, and as the gear rotates, there is a stringy webbing action carried from tooth to tooth by their contact with one another. Rotating of gears creates a web of strings that continuously stretches across the tooth faces. Acrolite Gear-Lube is claimed to afford continued protection by redistributing itself over the critical area. Even under wet or dry conditions, dusty or clean, Gear-Lube clings to the frictional surfaces, with a grip that normally outlasts several coatings of conventional lubricants, it is announced. This heavy-duty lubricant spray sells for around $2.00 for a 16-oz can. Acrolite Products, Inc.

5—FEEDER PUMPS incorporate design improvements

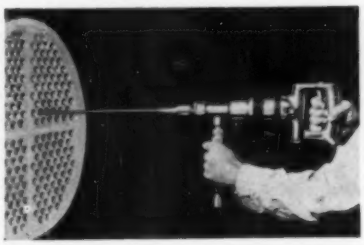
Controlled volume pumps in the new Milroyal line use a minimum of working parts and bearing surfaces to translate high speed rotary motion to low speed reciprocating motion. Totally enclosed, this speed reducer is an integral part of the pumps and runs in an oil bath. This combined Polar-Crank drive unit and speed reducer permits manual or automatic adjustment of capacity from 0 to 100 percent. The capacity adjustment closely approximates a liner



relationship and can be made while pump is running. It is noted that the plunger of the pump always returns to the same forward position on each stroke regardless of stroke length to assure maximum displacement efficiency. Initial units of the Milroyal line are offered with company's Step-Valve alloy steel liquid ends providing repeatable accuracies given as ± 1 per cent. Using standard speed motors, several of these controlled volume pumps can be coupled to a single motor yet each pump will have its individual capacity adjustment. The pumps have maximum capacities to 29 gph and meter against pressures as high as 1900 psi. Milton Roy Co.

6—CONDENSER CLEANER for tubes up to 1-in. diam

Designed to clean, thoroughly and quickly, even severely clogged tubes up to 1-in. diam, the redesigned CC-475 Condenser Cleaner weighs only 10 lb, and can be operated by one man without

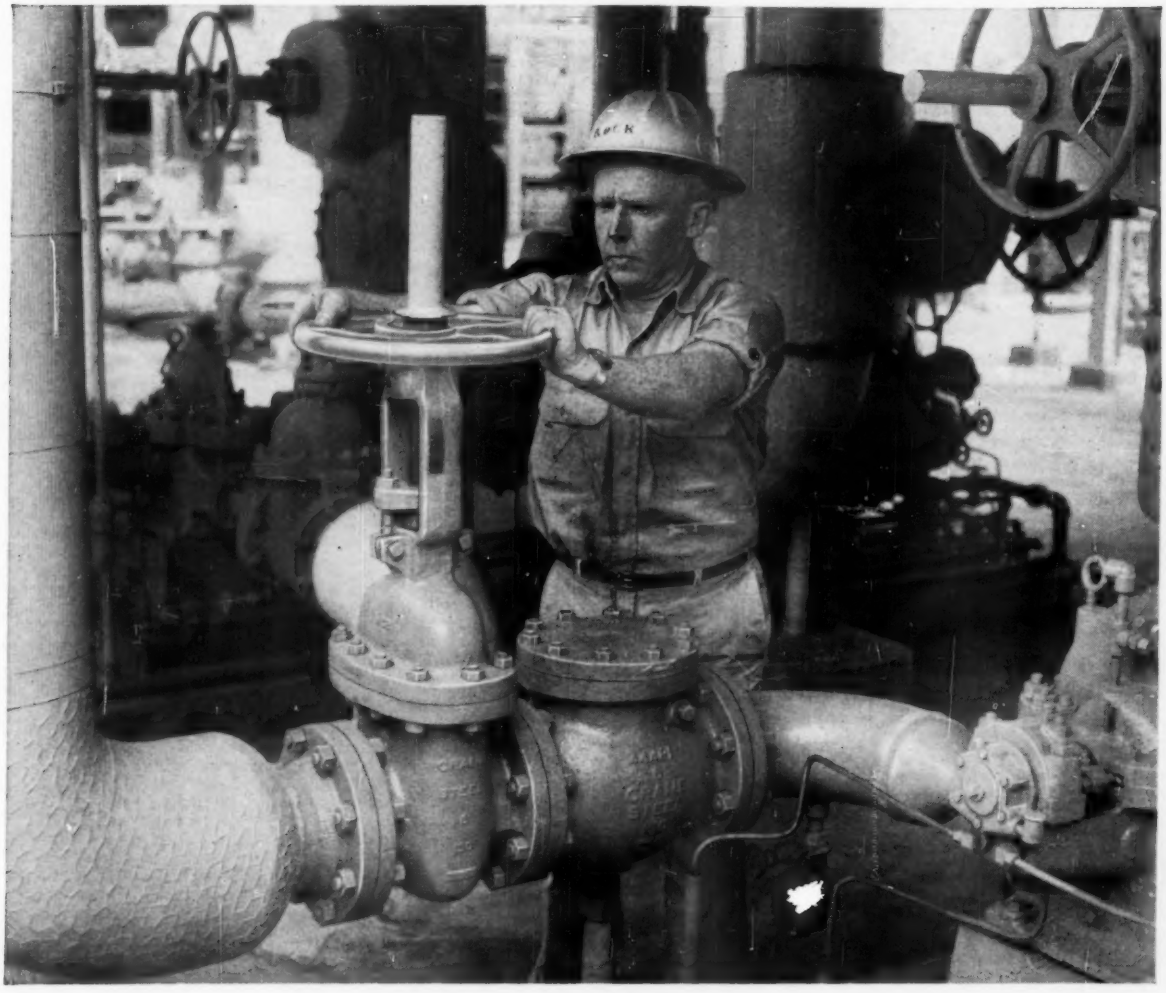


use of supporting rigging. A single-stage geared air driven motor powers the unit. The motor operates at 3800 rpm, and its speed is controlled by a feathering valve at the handle. This motor runs quietly, says company, and a built-in flushing system controlled by a stainless steel sleeve valve cools drill head and removes cuttings. Airetool Mfg. Co.

7—STEAM GENERATOR is compact, high efficiency unit

Production of 5000 lb of steam per hour from an overall floor area of 8 by 7 ft, is claimed possible for this dry land adaptation of company's marine steam generator. Only 7-ft high, this compact gen-

Gasoline Plant Cuts Valve Maintenance Costs



Crane Valves Do the Job After Others Fail

Six years ago this large gasoline plant in the Southwest, installed new gate and swing-check valves on hot water pump lines handling boiler make-up water.

Bonnet joint leaks and seat leakage developed after a short time. Maintenance costs jumped. After many attempts to stop the leakage, the bonnet joints were welded shut.

Two years ago the valves finally had to be replaced. Six-inch, 150-pound Crane steel gate and swing-check valves were installed.

Today these Crane valves continue to operate without any leakage at bonnets or seats, and without a penny spent for maintenance.

Why are the Crane valves still operating *with* 100% efficiency and *without* maintenance? *It's Crane quality*—in design, materials and workmanship—that makes the difference!

For information about Crane steel valves for all services—power and process fluids handling—see your Crane Representative, or write to the address below.

IDEAS FOR YOU—This free book gives you 32 case histories of important savings with quality valves. Ask for "Valve Performance Facts."

CRANE VALVES & FITTINGS

PIPE • PLUMBING • KITCHENS • HEATING • AIR CONDITIONING

Since 1855—Crane Co., General Offices: Chicago 5, Ill.—Branches and Wholesalers Serving All Areas

For more data circle 550 on Post Card

erator is said to obtain 150 hp in less than half the space required for many packaged steam generators, and it is designed to modulate over a wide range with high efficiency. An oil pump set is furnished factory installed to save space and reduce installation cost. Water treatment tanks are mounted on the side of the boiler shell and piped to the feedwater pump system. By-pass piping permits manually controlled water circulation, it is pointed out. Cyclotherm Div., National-U. S. Radiator Corp.

8—CONVEYOR IDLERS come in varied sizes and types

Offered in five series and in widths ranging from 14 to 84 in., this line of belt conveyor idlers has increased the number this manufacturer's idler variations from 38 to 64. In all, the line includes more than 630 different types and sizes. The five series of idlers, Series 5000 through 9000, make possible exact matching of idlers to specific operating requirements of all belt conveyor applications. In addition to flat, 20-deg and 45-deg troughed idlers, others included are rubber cushioned idlers for use at loading points; positive action and actuating disc training idlers, and variable troughed idlers. Idlers feature inverted angle bases, and removable steel retainer clips at each bracket to hold rolls in position. Link-Belt Co.

9—POWER PUMP, low cost, of aluminum bronze

Developed as an inexpensive waterflood and salt water disposal pump for oil fields, Model KCA Power Pump is also suggested for light duty industrial use. It is made of corrosion-resistant aluminum bronze. Features announced include inter-changeable plungers over widest available diameter range (1¼ to 2½ in.); straight-flow design for maximum volumetric efficiency; and large pipe connections, 3-in. suction and 2-in. discharge on either side. Bulletin 3209-B1 covers it. Worthington Corp.

10—WIRE, CABLE CLAMP reduces installation time

Claimed for the French Self-Locking Clamp are a 30 to 50 per cent reduction in labor and installation time compared with older types of clamps; test reports showing that it holds without

slipping beyond the breaking strength of guy wires and cables; and performance records showing it does the work of two or three older style clamps. It has four parts: a housing with two adjustable hard steel rollers (which lock the wire or cable by friction), two clips that slide over the main body of the housing, and rollers and a safety bar that slides in between the clips to lock them. The clamp weighs only 1.2 lb and takes wires or cables 5/16, 11/32, 3/8 in. etc. It is also suggested for use with rope. Clamps, Inc.

11—LOW COST ENTRAINMENT SEPARATOR for steam, air and gas applications

Improved Type T Separator utilizes centrifugal force to separate moisture and oil entrained in vapor flow. As illustrated, the steam, air or gas is directed through an annular passage which increases its speed to produce a maximum of centrifugal force. Entrained matter, which then clings to the outer wall drains to the bottom of the separator and to an automatic trap. The entrance to the outlet chamber has been enlarged to provide for reduced velocity at that point and eliminate re-entrainment problems. The force of flow and simple bottom collecting section make this a self-cleaning unit, and the straight through pipe connections permit easy installation, manufacturer points out. This new series of entrainment separators is available with screwed connections through 3-in. pipe sizes, and 125-lb ASA flanges to 8-in. size. Wright-Austin Co.

12—FUEL OIL HEATER for high temp hot water systems

Design features incorporated in the Paracoil Thermo-Film Heater are reported to make this safety-barrier type fuel oil heater suitable for direct use in oil-fired high temperature hot water systems. A single Thermo-Film Heater provides adequate oil temperature, isolates the HTW circuit from the oil circuit, and requires less space, manufacturer announces; it is also simple to operate and costs less to install. A number of double tube elements — one tube inside another — are enclosed within the heater shell. Oil to be heated flows through the shell. Boiler water flows in the opposite direction through the inner tube. Separating the oil and water is a thin film of heat transfer fluid in the space between the tubes. It is pointed out that, should an oil tube failure occur, free oil cannot contaminate the HTW stream as it becomes trapped in the heat transfer liquid system and rises in the expansion chamber sight glass to warn operating personnel. Davis Engineering Corp.

13—HYDRAZINE PRODUCT for boiler feedwater treatment

Hyzeen is announced as a 35 per cent aqueous solution of hydrazine that is non-flammable and has neither flash nor fire point. Manufacturer says it is safe and presents no unusual handling or storage problems. According to manufacturer, Hyzeen is preferred over sodium sulfite for removal of oxygen from feedwater for high pressure boilers, and it is a proper oxygen scavenger where demineralized or evaporated makeup water is used and where it is important to maintain low boiler water solids. Hyzeen reacts with oxygen without adding dissolved solids to the water, it is noted. Betz Laboratories, Inc.

14—FUEL OIL ADDITIVE is triple-action product

A triple-action, alkaline fuel oil additive, KOR assures better combustion economically, manufacturer claims, and holds oil, water and sludge in suspension. It is also reported to increase rate of combustion and cut fuel costs because it makes all the combustibles go to work. Elimination of soot and carbon scale from the heating surfaces makes manual cleaning unnecessary. Stack temperatures and smoke nuisance are also said to be reduced. KOR is described as non-explosive, non-corrosive, rust-resistant and prevents formation of hydrochloric acid in furnace, fuel tank. KOR Corp.

15—LIGHTING FIXTURE is quick-disconnect unit

Type VNF is announced as a quick-disconnect vaportight lighting fixture which can be installed and removed in seconds. In an area where a lighting fixture might ordinarily be an obstacle, but light is sometimes needed, the Type VNF is reported particularly useful. It is also suitable for locations where a few fixtures can be used to do the work of many. Weatherproof receptacles can be installed, indoors or outdoors, and the fixture carried from place to place. Crouse-Hinds Co.

16—ALUMINUM CLEANER restores the surface luster

GH-30 is claimed to cut through grease, grime and dirt in a fraction of the time required by many cleaners. It is as mild as bath soap and harmless to the user, manufacturer states, and it will not etch or scratch aluminum. Also, it is said to contain ingredients which retard future dirt formation so that aluminum need not be cleaned as often. According to company, GH-30 may also be used to clean stainless steel, and it will not harm painted areas or corrode ferrous metals. Reported economical and easy to use, this cleaner mixes in solution with water up to 10 to one. To clean, you merely wet the surface, apply GH-30 and let it stand for a few minutes, then hose off. Chemco.

17—DIGITAL DEVICE records operations, handles data

With this recorder, the number of units produced during a preselected time interval may be counted. Operated by electrical impulses from any conventional contact device, the recorder is designed to produce a permanent record on punched paper tape. The tape record may be interpreted visually or used with automatic data processing machines.

One of two Permutit Automatic Valveless Water Filters at O. M. Scott & Sons Co. Chemical Products Plant, Marysville, Ohio. Each filter is 7' diam. and rated at 116 gpm. The complete Permutit water-treatment system was engineered by H. A. Williams and Associates, Columbus, Ohio.

"No maintenance or operating expense with our PERMUTIT Valveless Filters"

- These filters have been operating continuously for over a year and a half . . . supplying water for process, boiler feed and drinking. They follow a Permutit Precipitator that treats raw well water with lime, soda ash and coagulants. Either filter can handle full feed rate during inspection or repairs on the other.

- Here's how Glenn L. Moll, Scott's Service Manager, puts it: "Our Permutit Automatic Valveless Filters are operating very satisfactorily. The filter-bed and underdrain system stay clean with no evidence of blow holes or sifting of filter media to the underdrain system. We now inspect them only twice a year."

- The Valveless Filter is completely automatic—yet costs up to 45% *less* than conventional automatic gravity filters because it uses no expensive valves, flow controllers, pumps or hydraulic or pneumatic control systems.

Send for descriptive bulletin. Address: The Permutit Company, Dept. PE-12, 50 West 44th Street, New York 36, N.Y. or Permutit Company of Canada, Ltd., Toronto 1, Ontario.

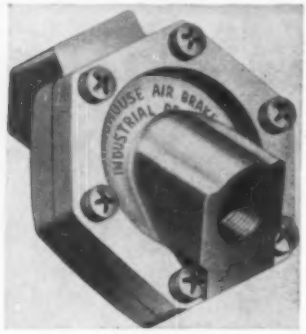
PERMUTIT®
rhymes with "compute it"
A DIVISION OF PFAUDLER PERMUTIT INC.
Water Conditioning
Ion Exchange • Industrial Waste Treatment

For more data circle 551 on Post Card

Periods of peak production efficiency and of unproductive or machine down time are readily determined, it is noted, and a cumulative production total is also presented. An adaptation of company's Digital Demand Recorder, in use in demand recording and load survey work for utilities, this new instrument is offered with standard time intervals of 5 to 60 min. Fischer & Porter Co.

18—RELEASE VALVE for cylinders, pneumatic devices

Faster, more efficient air-pressure venting of cylinders and other pneumatic devices is claimed for this quick release valve. Among features announced are greater capacity, greater sensitivity and reduced weight. According to company, this valve is so constructed that it may



be mounted on a rotating or revolving device and the centrifugal force will not impair its operations. Also, the supply port may be assembled on the valve in one of two positions, allowing inlet and outlet ports to be mounted on the same center line or at right angles to each other. Long service and minimum maintenance are attributed to aluminum construction — an oil-resistant diaphragm is the only wearing part. The diaphragm design is said to provide quiet operation. The valve is normally mounted directly in the piping, but a mounting bracket can be had as an accessory. Westinghouse Air Brake Co.

19—ANALYZER measures one gas in multi-component mixture

For selective and continuous measurement of concentration of one gas in a multi-component mixture, the M-S-A Gas Thermatron is designed for accurate gas analysis without chemical or physical changes of the gas mixture. According to company, it provides an improved means of utilizing the thermal conductivity principle of measurement with additional convection cells which take into account differences in convective heat losses from hot filaments through gases. Since convective heat loss varies with both molecular weight of gases and diameter of cells, convection cells of different diameter are provided to take advantage of optimum thermal convection loss of each gas.

There are four cells with hot filaments in this instrument: two conduction cells of small diameter and two convection cells of selected large diameter. Filaments of these cells are the arms of a Wheatstone bridge circuit arranged with two parallel branches comprising one small filament cell and one large filament cell in series, and annulling resistors. The instrument can be calibrated for any gas over narrow (0 to 1 per cent) or wide (0 to 100 per cent) ranges of gas concentration. Applications include process control, control of atmospheres and combustion, determination of gas purity. M-S-A Gas Thermatrons draw 100 w. Sample requirement is 100 to 1000 c c per minute. No pump is required. The instrument can be compensated for water vapor or, if desired, it can be measured. Units can be supplied on a steel panel or in a cabinet as part of a complete sampling system. Mine Safety Appliances Co.

20—TUBE ROLLING CONTROL comes in two sizes

Depending on the size of the tube rolling job, either the standard or heavy-duty models of this air magnetic control may be used. The standard control, weighing only 10 lb, features a pistol grip with squeeze trigger. It is only 10¼ in. long and has a motor speed of 1000 rpm. The heavy-duty control, weighing 12½ lb, is controlled by a valve handle at the rear. Both models are advantageous for tube rolling in hazardous locations, it is pointed out, and they are not affected by fluctuations in the motivating air. Bulletin Y-53 provides data on the control. Elliott Co.

21—NETWORK TRANSFORMER is lower and lighter

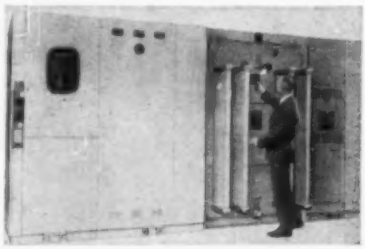
Design changes in this vault network transformer have enabled size and weight reductions of about 15 per cent. Transformer's tank design increases cooling area over conventional tubes, it is claimed, and its corrugated surface makes for a stronger tank. Easily accessible radiating surface facilitates painting and maintenance. All accessories are located in the same work area for convenience of testing and inspection. Allis-Chalmers Mfg. Co.

22—CHECK VALVE prevents indicating liquid overflow

For use with manometers and liquid-level gages, the Series 8838 Overflow Check Valve is designed to prevent blowing-out of the indicating liquid. Installed at the top of the instrument, the valve closes at the onset of overpressure and opens automatically when the overpressure is removed. It is intended for use with all indicating liquids, at pressures up to 500 psig, and can be furnished with inlet and outlet threaded to fit practically all manometer and gage installations. Catalog 2008 gives details. King Engineering Corp.

23—LOAD CENTERS serve electrical distribution needs

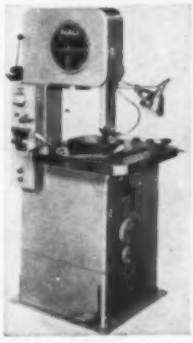
Nine new models of this company's packaged substations, called Tranfo Units, extend coverage of the line to more than 90 per cent of all industrial and commercial applications, it is announced. These are pre-engineered load centers for stepping down primary voltages; they contain both the transformer



and its primary protective and secondary distribution devices. Manufacturer points out that these packaged substations offer great savings over custom-designed systems because: no special engineering time is required, and installation time and expense are minimized. Sixteen basic types of Tranfo Units cover both indoor and outdoor applications. Units come in ratings from 45 to 3000 kva for stepping down primary voltages from 2.4 through 13.8 kv to 208/120 through 600 v. Four types of transformers are available: oil filled askarel filled and sealed or ventilated dry types. Transformer and Rectifier Div., I-T-E Circuit Breaker Co.

24—MAGNETIC CONTROLS have dual-function feature

Now in production are four new top-mounting tandem-displacement type Magnetrols, two for flanged mounting and two for screwed mounting. They combine functions of two separate controls with only one tank opening, provide two level stages — wide differential for control of two pumps or one pump and high or low alarm. A feature is ability to "change" switch actuation points by merely sliding the displacers up or down as desired. They lock to the stainless steel stranded cable stem by means of cable clamps. The units are factory set for individual application requirements, company points out, and factory settings can range from 0.35 specific gravity to 1.8, but depending on displacer material furnished. Glazed porcelain displacers are standard, but Karbate or stainless steel displacers can be furnished. Magnetrol, Inc.



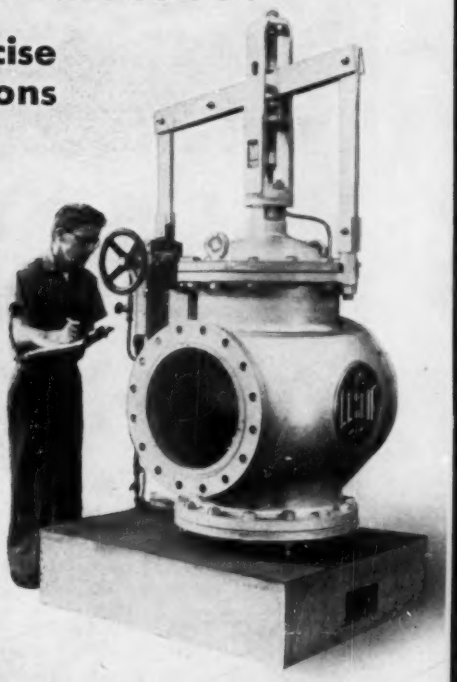
25—CONTOUR MACHINE is versatile shop tool

Model 16M Contour Machine is announced as offering the versatility, adaptability to many materials, and speed and safety required for maintenance shop use, and as having the additional advantage of low first cost. This one machine with standard attachment shapes parts needed for maintenance work, says manufacturer, and produces them faster, cheaper and more safely than if made by other machines. There are few material limitations because the 50 to 5200 fpm range provides proper speed for many jobs, from slow for band filing, to fast for friction sawing of light sheet.

Foot controlled power feed minimizes operator fatigue and a work light is provided to enable close work without eyestrain. The work-table tilts 45 deg for angle cutting jobs. This feature, together with the mitering attachment, is reported particularly valuable to process industries. Compound and simple angles can be cut for making special

LESLIE - *lifetime control valves . . .*

A complete line for precise power applications



Leslie Co. offers a wide range of single seated valves in sizes ½" to 16" and double seated control valves. In addition, there are many new standard valves designed specifically for power industry applications in both sub-critical and super-critical power generating stations. Valves are available with these power service features:

- **Exclusive Leslie seat protections eliminate erosion problems in high-pressure drop throttling services.**
- **New Leslie "cage" construction permits replacement of inner valves, seats and guides without removing valve body from the line. Down-time for replacement or inspection is cut to a minimum less than 20 minutes.**
- **Control valves in extremely severe high-pressure drop service have infinite rangeability.**
- **Stellite faced and solid stellite inner valves and seating surfaces for maximum erosion resistance.**

Leslie control valves are designed to handle hot and flashing condensate . . . temperatures to 1150°F per ASA rating. They are providing reliable service under extremely severe operating conditions in a variety of central station applications such as:

- **Condensate drains from feedwater heaters**
- **Boiler feed pump recirculation**
- **Desuperheater spray water control**
- **Turbine load drain remote manual start-up control**

You may choose from a variety of sizes and diaphragm actuators to accommodate almost any operating air supply up to 100 psi. In addition, electro-mechanical, pneumatic cylinder and electro-hydraulic actuators can be supplied.

For specific engineering data, write today for data sheets illustrating the cage trim construction and other Leslie features.

LESLIE TRADE MARK

REGULATORS and CONTROLLERS

LESLIE CO., 301 Grant Avenue, Lyndhurst, New Jersey

CRISS CROSS

The Stronger, Longer Wearing, Better Lubricated Packing by **BELMONT**

A revolutionary braided construction, requiring special machinery—every strand in CRISS-CROSS Braid passes diagonally through the body of the packing, hence each strand becomes an integral part of the whole.

With CRISS-CROSS Braid, there is no outside layer to wear off, ravel, disintegrate.

This solid, integral braid is stronger, requires less gland adjustment. With its lubrication locked into the weave, it is more flexible and stays so.

For longer service life than any conventionally braided packing can offer—specify Belmont CRISS-CROSS.

Made in white and blue asbestos. TEFLON*-impregnated asbestos, and pure TEFLON.

ask your BELMONT Distributor

such leading Packing Distributors as:

Speck-Marshall Co. in Pittsburgh

and

San Antonio Machine & Supply Co. in San Antonio, Waco, Corpus Christi

are ready to serve you promptly and helpfully, wherever you are.

Write for Catalog 56.

The Belmont Packing & Rubber Co.

Butler & Sepviva Sts., Phila. 7, Pa.

*duPont Trademark

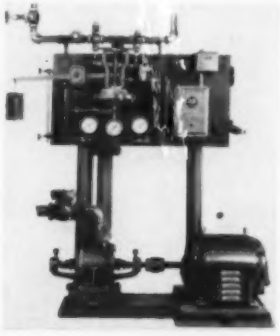
BELMONT

For more data circle 553 on Post Card

fittings and complex piping systems. Also, the speed and power of the Model 16M permits cutting stainless steel, Monel and other tough alloys, it is pointed out, and the $\frac{1}{16}$- to $\frac{1}{2}$-in. range of saw band widths permits small and intricate contours to be followed. The Do-All Co.

26—BOILER RETURN SYSTEM offers improved performance

Better performance with lower operation and maintenance costs are claimed for this improved differential drainage and boiler return system. It is designed for food and chemical processing plants, petroleum refineries, paper mills, laundries and wherever steam is used for processing at pressures over 30 lb. Features announced include a two-stage pump to replace the dual pump arrangement formerly used, floatless liquid level



control, chrome plated pump internals, and Teflon packing in differential valve.

The system is said to return condensate from steam processing units to the boiler at 300 F or higher — only 15 to 30 deg less than the temperature at operating pressure. This lowers fuel costs 10 to 25 per cent over most open systems, according to manufacturer, and raw water make-up requirements are reduced up to 90 per cent. A differential valve is provided to automatically maintain any desired differential in pressure between steam in boiler and pressure in the system's receiver tank. Since the system requires only 25 lb pressure differential, power required for pumping is reduced 75 per cent, it is stated. Stickle Steam Specialties Co.

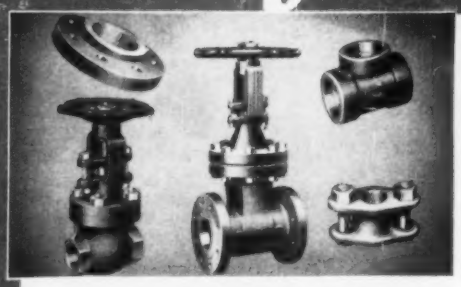
Described on these pages are new and improved products. Use Reader Service Cards on pages 119–120 to ask for more information on them. Just circle the item numbers of all the products in which you are interested.

27—SHUTOFF VALVE, 5000 psi, operates by 10 lb torque

Easy-on-and-off control of hydraulic circuits operating at pressures to 5000 psi is claimed for the Ez-O-Trol, an in-line shutoff valve designed for applications where liquid is not subject to reversals of flow. In operation, valve is seated by back-pressure in a balancing pressure chamber. Actuating the pilot

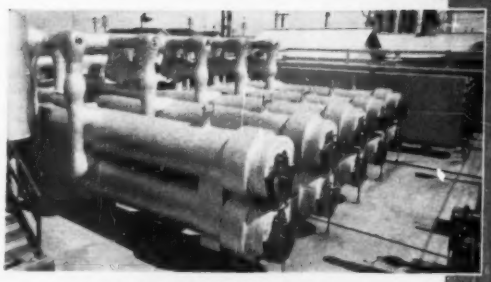
Vogt PRODUCTS

Designed for today's *Tough* service demands



FORGED STEEL VALVES & FITTINGS FOR TOUGHNESS AND TROUBLE-FREE SERVICE

Forged from carbon and alloy steels, Vogt valves, fittings, flanges and unions are built to safely handle liquids and gases at high pressures and temperatures in the modern petroleum refinery and petro-chemical plants. The complete line includes flanged, screwed and socket weld end globe, gate and check valves—ells, tees and crosses—couplings—bushings—plugs—unions—flanges and flange unions—and weld caps.

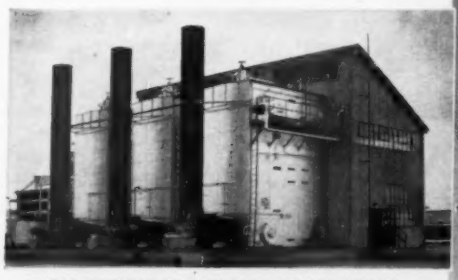


PROCESS EQUIPMENT FOR EVERY SERVICE

Vogt constructs process equipment in wide variety to all Codes. Stills and towers, oil chillers, crystallizers, heat exchangers, molding machines, etc., serve in the manufacture of oils, greases, 100 octane gasoline, synthetic rubber, chemicals and related products around the world.

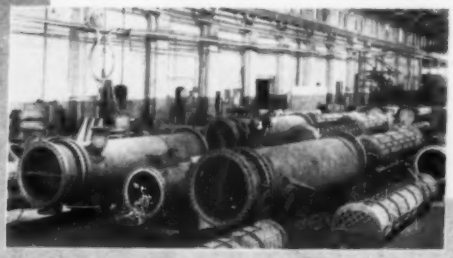
MORE REFRIGERATION TONNAGE AT LESS COST

More than 70 years of engineering and manufacturing experience is incorporated in Vogt refrigerating and ice making equipment. Compression Systems and Tube-Ice Machines in a wide range of capacities serve industrial and processing plants and institutions here and abroad.



HIGH EFFICIENCY STEAM GENERATORS

Vogt steam generators are designed to give maximum rating in a minimum of space, with high efficiency and low maintenance expense. Bent tube and straight tube designs are available for solid, liquid or gaseous fuels to meet every power, process or heating requirement.



SPECIAL MATERIALS COMBAT CORROSION AND PRODUCT CONTAMINATION

Our modern shops produce a wide variety of equipment from special metals and alloys to fight corrosion and product discoloration or contamination. Fabrication procedures insure that corrosion resistant properties of welds will match that of the materials used to construct the equipment.

HENRY VOGT MACHINE CO., LOUISVILLE, KY.

SALES OFFICES:
New York, Chicago, Cleveland, Dallas, Camden, N. J.,
St. Louis, Charleston, W. Va., Cincinnati

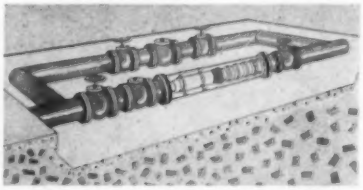
PRODUCTS FOR REFINERIES, CHEMICAL PLANTS, POWER PLANTS AND PROCESS INDUSTRIES
Write for literature, Dept. 24A-GPE

For more data circle 554 on Post Card

causes an unbalanced condition by allowing back pressure to escape. This opens the valve to practically unrestricted throughflow, company states, resulting in low pressure drop. Pilot operation may be directly controlled by a turn of a handle having less than 10 lb torque, or remotely controlled by 50 to 150 psi air-operated diaphragm, or direct-acting solenoid. Pilot controls are external and interchangeable on same size body. The manually controlled type may be panel mounted. In standard units the valve body is aluminum alloy, with internal parts of stainless steel. Size range is ½ to 2 in., temperature range, −65 to 200 F. Republic Mfg. Co.

28—SUBMERSIBLE PUMP is suspended in the pipe line

The Power-Line is a submersible pipe line booster pump designed to operate in a horizontal position within pipe line itself. It is suspended within a special



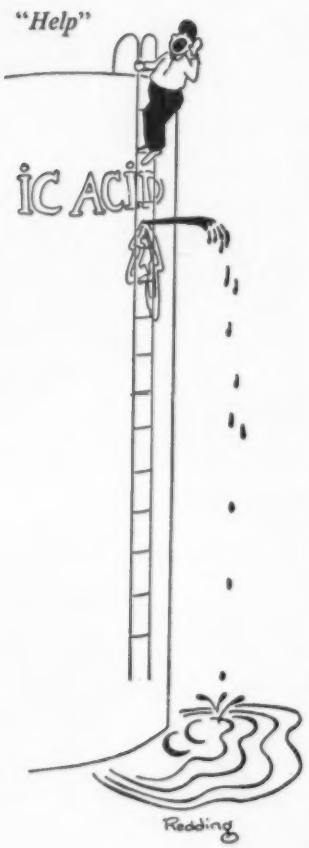
section of the pipe line which is flanged at each end and becomes an integral section of the line. The motor is centered and held by spiders within this section. The line liquid is drawn past motor and into bowl assembly which passes it along at increased pressure. The submersible power cable leads to a terminal box mounted on outside of special section and from there runs to a control box. Pump will give capacities from 100 to 4000 gpm in heads from 50 to 500. Layne & Bowler Pump Co.

29—PIPE SQUEEZER equipped with mechanical locknut

The locknut feature in this hydraulic pipe squeezer is designed to assure positive mechanical locking even with temperature fluctuation over extended periods of time. Pipe squeezer is a regular

tool for cold and hot pipe pinching, having a variety of uses including relocation of service lines and mains; repair of leaky and ruptured lines and mains; speeding of trenching operations; shutting off service to buildings threatened by fire when valves are inaccessible; permanent closing of service lines. Described as light, compact and easy to carry and

Life in these excited states...



Ever "Treed" by Corrosion?

Ever left high and dry by corrosion . . . sweating out repairs, shut-downs, wasted materials? You can solve 85 to 100% of these problems once and for all with Ace chemical resistant piping, valves, pumps, tanks and other equipment. It doesn't *cost* . . . it *pays*.

Best non-metallic pipe anywhere for *hot* chemicals to 275°F. Also handles tough organics. Rigid, tough nitrile. Pipe and fittings to 8". *Bul. 96A.*

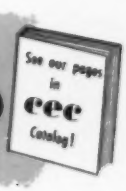
1001 uses. Nontoxic, odorless, tasteless, sterilizable, flexible tubing. Excellent for chemicals, foods, and for lab or machine lines. ¼ to 1¼". *Bul. 66.*

Heavy Ace rubber and plastic tank linings unexcelled for alkalies, acids, bleaches, salts. Faultless seams, indestructible bond, shock and age-resistant. All shapes. *Bul. CE-53.*

Special equipment often can be machined, punched or welded of standard plastic or hard rubber sheet, rod or tubing. Write for details today.

ACE processing equipment of rubber and plastics

AMERICAN HARD RUBBER COMPANY
DIVISION OF AMERACE CORPORATION
Ace Road • Butler, New Jersey



For more data circle 555 on Post Card

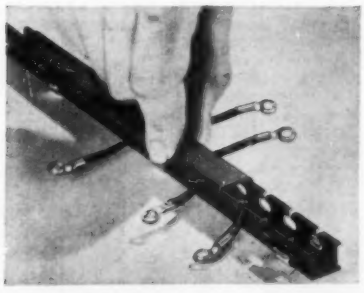
operate in confined areas, it operates in temperatures from −65 F to 160 F. Two models are available — Model 5024-S, a 40-ton capacity unit designed for use with cold steel pipe up to 2½ in. nominal size; and Model 5045-R, a 15-ton capacity unit designed for use with heated steel pipe up to 2-in. nominal size. Regent Jack Mfg. Co.

30—SAFETY CLEANER for heavy duty cleaning, degreasing

This safety cleaner and degreaser is furnished in high concentrations to be diluted with water to clean everything from conveyors to washrooms. According to amount of water used for dilution, Safety Spray can be used on machinery, motors, diesel equipment, etc., tile, glass, floors, exhaust fans in kitchens or cafeteria. It is claimed safe to use on aluminum and other soft metals. Described as non-flammable, non-toxic and harmless to hands, Safety Spray contains inhibitors to prevent rust and corrosion of metal surfaces. Spray application is recommended and manufacturer supplies metal piston type sprayer/fogger unit free on initial drum orders. Harco Chemical Co.

31—MINIATURE DUCT for economical electronic wiring

This vinyl plastic wiring duct comes in a full range of small cross sections, all having a snap-in slot design which allows wire to be laid after terminals have



been attached. Duct slots are separated by individual plastic fingers which flex enough to let wire be inserted in the slots, but snap back into place after insertion. The duct cover also snaps into place. This wiring duct is announced as making an economical, compact raceway for control panel assemblies and other electronic installations where space is limited. For standard mounting, an ordinary screw may be used through a hole drilled in the base. Panduit Corp.

32—BLOWDOWN UNIT is packaged, fully automatic

In addition to basic components of volume control valves, flash tank with drainer, and main heat exchanger, this total function packaged console type boiler blowdown system includes automatic sample cooling, illuminated sight flow indicators, stainless steel "knife-closure" dial-calibrated volume-control valves, automatic drain after-cooling, and automatic, timed, pressure flush for all strainer drains, flash tank, and heat exchanger. Console cabinet has pressure, temperature, and level instrumentation. Side, back, and front panels of blowdown console are removable for accessi-

Which of these characteristics are essentials on your Remote Control Jobs?

• Accuracy . . . High Load Capacity . . . Adaptability . . . Freedom from Trouble . . . Long Life . . . Flexibility . . . these are some of the qualities of ACCO TRU-LAY PUSH-PULL *flexible* CONTROLS that have made it possible to improve the operation of literally hundreds of mechanical products (list on request). Full description of this versatile REMOTE CONTROL is given in our **DATA FILE** available for your further study.

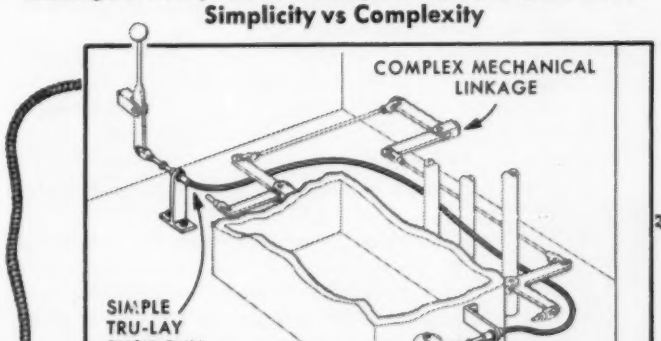
ACCURACY is inherent in the basic design, and in the standards of quality and precise dimension that control the manufacture of TRU-LAY PUSH-PULL CONTROLS. These are precision products, not gadgets.

VERSATILITY of this fine remote control can best be illustrated by citing some of the jobs it handles well . . . HOT jobs on jets and industrial furnaces . . . COLD jobs down to −70°F . . . WET jobs (the conduit can be completely immersed) . . . DIRTY jobs . . . ABRASIVE jobs . . . CORROSIVE jobs . . . HEAVY, TOUGH jobs up to 1,000 lbs. input . . . LIGHT DUTY jobs . . . REMOTE jobs 150 feet or more from the control point. These units are frequently and successfully used in conjunction with electric, hydraulic and air controls . . . are thoroughly effective under almost any operating condition.

"Solid as a rod but *flexible as a* wire rope" aptly describes TRU-LAY PUSH-PULL CONTROLS. This flexibility provides positive, remote action whether anchorages are fixed or movable . . . it damps out noise and vibration . . . protects delicate instruments . . . it permits ease of handling and shipping even when assemblies are 100 or 150 feet long . . . it avoids the risk of damage always present with solid tubular controls that must be preformed to position . . . and flexibility greatly simplifies installation of controls by reducing the number of working parts and by making it possible to snake around obstructions.

Advantages of Tru-Lay Push-Pull flexibility and simplicity are pictured below

Simplicity vs Complexity



Compare the TRU-LAY PUSH-PULL cable in illustration with the mechanical linkage. PUSH-PULLS are simple, have but one moving part, are noiseless and give lifetime service accuracy. Linkages are complex, made of many parts; they wear at many points. Their use brings increased back-lash, lost accuracy and vibration rattles.

• Whether your interest is in a single application of this versatile PUSH-PULL CONTROL, or in its inclusion as a component of the product you manufacture, the six booklets and bulletins in this **DATA FILE** will answer your further questions, and will also provide you with the means of defining to us the applications you may be interested in.

Write for a copy without obligation

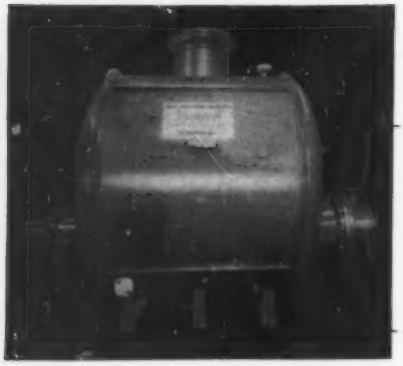
ACCO

AUTOMOTIVE and AIRCRAFT DIVISION
AMERICAN CHAIN & CABLE

601M Stephenson Bldg., Detroit 2
2216M South Garfield Ave., Los Angeles 22 • 929M Connecticut Ave., Bridgeport 2, Conn.

For more data circle 556 on Post Card

Paracoil
EVAPORATORS



Paracoil Makeup Feed Water Evaporator now serving the City of Columbia, Missouri power plant. Consulting Engineers, Lutz and May, Kansas City, Missouri. Rated at 6,000 lbs. of steam per hour at 30 psia, with carry-over not exceeding 1 PPM. Built to ASME code requirements.

creatively engineered by Davis for installation in numerous public and private power plants

Davis Engineered Features

- All tubes and rolled tube joints can be hydrostatically tested without removing tube bundle.
- Tube bundle, with outside packed floating head, has free movement to allow for expansion and contraction.
- Any tube can be replaced without disturbing adjacent tubes.
- No internal steam connection or blind gasketed joints.
- Removable tube bundle.
- Pitched tube bundle to provide for complete drainage of condensate.
- Tubes arranged on wide square pitch to facilitate mechanical cleaning.
- Straight tubes of equal length to simplify tube stocking.
- Single-pass tube bundle for maximum free flow area of steam in tubes and minimum pressure drop through tube bundle.

Paracoil Evaporator Installations include the following:

Puerto Rico Water Resources Authority
Consulting Engineers: Jackson & Moreland, Boston, Massachusetts

Borough of Wellington, Connecticut
Alabama Electric Cooperative, Inc., Andalusia, Alabama
Consulting Engineers: Burns & McDonnell, Kansas City, Missouri

Western Electric Cooperative, Inc., Andarko, Oklahoma
Consulting Engineers: Loramore & Douglass, Inc., Chicago, Illinois

City of Bryan, Texas
City of Lafayette, Louisiana
Consumer's Public Power District, Ogallala, Nebraska
Consulting Engineers: Lutz and May, Kansas City, Missouri

Davis Makes it — Better! ***Write for Bulletin 1000***

DAVIS ENGINEERING CORPORATION

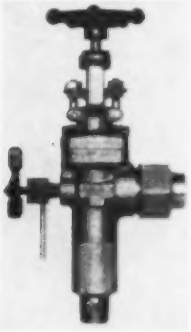
30 Rockefeller Plaza, New York 20, New York • Circle 6-5650

For more data circle 557 on Post Card

bility. Unit comes complete with matching sink for testing water samples. Console can be made to accommodate two, three or four blowdown stations, with total capacity up to 5000 lb blowdown per hour, for either 250 or 600 lb maximum working pressure. Fred H. Schaub Engineering Co.

33—SPECIALTY VALVE for process applications

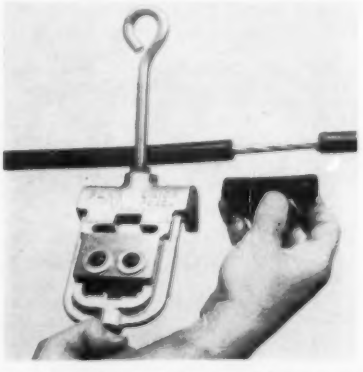
Type 5560-S Stop and Bleed-off Valve is an angle type, with a ¾-in. male NPT inlet, ¼-in. female NPT union outlet, and a ¼-in. NPT bleed-off valve connec-



tion; its ratings are 600 lb at 910 F and 2000 lb at 100 F. Outside screw yoke and body come in forged carbon steel or in Types 304 or 316 stainless steel. Primarily an instrument valve with many applications in process units, the Type 5560 can be used as a stop valve between pressure source and pressure indicators, recorders and transmitters. The bleed-off design permits safe removal of pressure instrument, it is noted; bleed-off may also be used for bleeding-off vent pressure trapped in system above valve seat. Manning, Maxwell & Moore, Inc.

34—INSULATION STRIPPER won't nick or scratch conductor

Hard-to-remove insulations, such as linear polyethylene, can be quickly stripped with the Penn-Peeler, it is announced, without nicking or scratching



the conductor. It is designed to remove a 2½ in. length of polyethylene, PVC, rubber or Neoprene insulations from 3/64 to 12/64 wall on conductors ranging from 2 STR. to 4/0 ACSR. One basic tool is used with individual, interchangeable, cutter blades for each conductor and insulation combination. All that is necessary is to hook Penn-Peeler

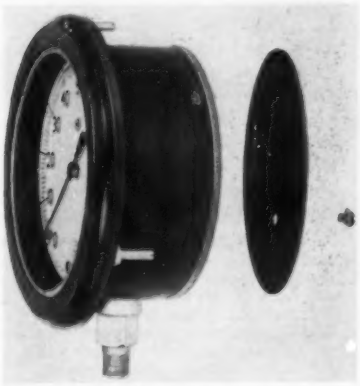
over the insulation, tighten up by hand or with a hot stick until a stop is reached, and rotate around conductor. The insulation chip falls away, exposing conductor. Penn-Union Electric Corp.

35—VOLTAGE SENSING RELAY opens and closes circuits

This differential voltage sensing relay employs a simple printed circuit with a standard plug-in SPDT relay to open and close circuits. A zener diode and transistors employed in the sensing circuit assure high sensitivity, according to manufacturer. The plug-in relay is a stock model, reported to afford positive, consistent response without chatter. The unit is designed to provide a control range of 70 to 100 per cent of rated voltage for both drop-out and pick-up with a minimum 1-v differential. Accurate settings are obtainable by using variable potentiometers for pick-up and drop-out control. These are calibrated for adjusting convenience between 70 to 100 per cent. Relay is designed for d-c service of both 6 to 49v, and 50 to 250v. The a-c service range includes both single phase and three phase, three-wire and four-wire. Lake Shore Electric Corp.

36—PRESSURE GAGE with solid metal front plate

In the Safe-T-Case Gage, departure from normal construction consists mainly of a solid metal front plate which forms a partition or protecting wall between dial and tube. In the event of a bourdon tube rupture, this partition is designed



to divert the force of a burst in a backward direction, away from the operator, where it is permitted to escape by deforming the back cover plate. The gasketed and deformable back plate covers the entire rear of the unit and can be forced open by a minimum pressure of 3 psi. For added safety in the event of a high pressure surge, this back plate, which is screwed in place, will not detach itself from the gage, it is noted. The readily removable plate provides access to the tube and movement assembly without necessity for removing the indicator dial. Four types of bourdon tubes are available. Helicoid Gage Div., American Chain & Cable Co., Inc.

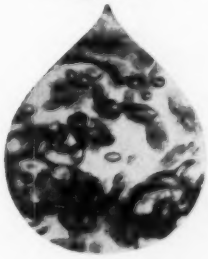
37—LIQUID VALVE closes when the power fails

For remote control operation, this heavy-duty valve is opened and closed by a built-in electric motor. A fail-safe mechanism is incorporated to close the

CONCENTROL
PROVIDES
LOW COST, EFFECTIVE CONTROL of FOAM and BOILER WATER CARRY-OVER

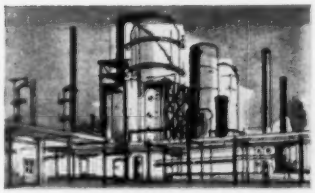
PROVED IN THE LAB:

BEFORE: Foaming of highly alkaline solutions in glass test cylinder.

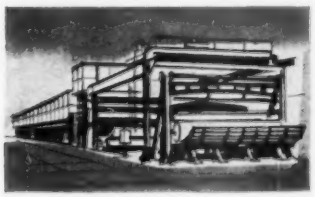


AFTER: Same solution after addition of 12 ppm of Bird-Archer Concentrol antifoam.

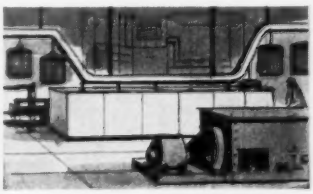
PROVED IN THE FIELD:



Concentrol eliminates foaming, maintains dissolved solids of 10,000 ppm with alkalinity in excess of 2,000 ppm in East Texas refinery.



Concentrol reduces blowdown rate from 15% to 5%, keeps steam quality high in paper mill using highly alkaline makeup water.



Concentrol eliminates boiler carry-over caused by high alkalinity for an automobile radiator manufacturer using a carbonate water that is Zeolite softened.

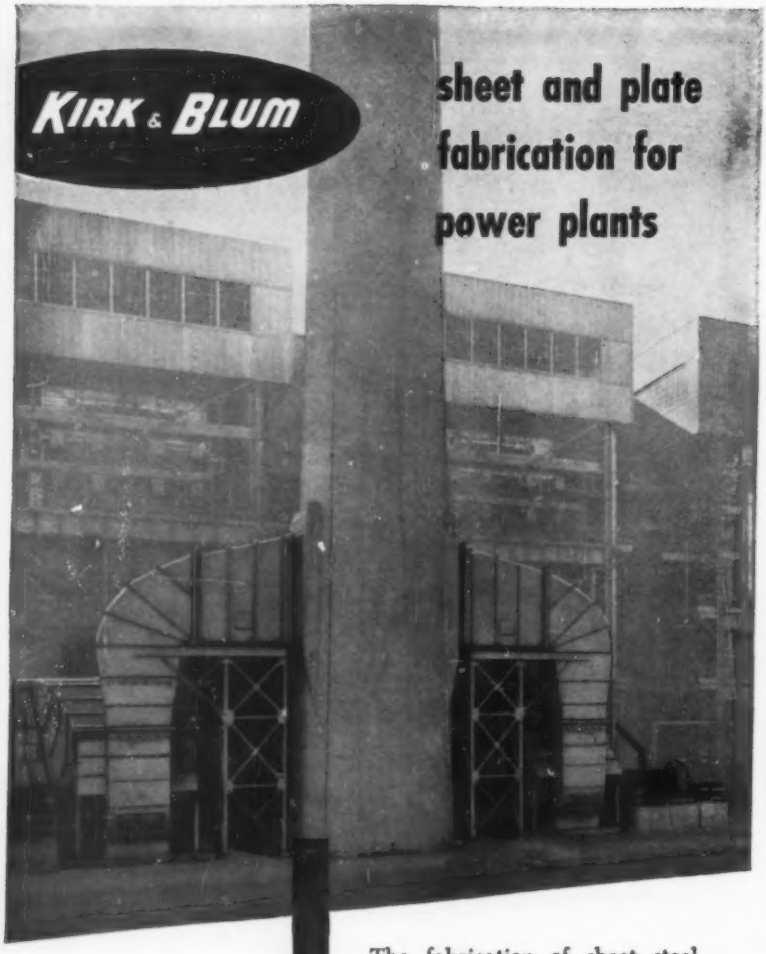
Concentrol is available in liquid, powder or briquette forms. Fast acting and resistant to hydrolysis or breakdown under normal boiler temperatures and pressures, it can be fed either continuously or in slugs to boilers. Many plants get the advantages of positive foam control *plus* boiler water sludge conditioning by using Concentrol in combination with organic sludge conditioning agents.

Let a Bird-Archer Water Treatment Engineer prove what Concentrol can do in your plant.
Bird-Archer is always as near as your phone.

8A-802

BIRD-ARCHER
WATER TREATING CONSULTANTS
The BIRD-ARCHER Company, 4337 N. American St., Phila. 40, Pa.
New York, Chicago
The BIRD-ARCHER CO. of California, 415 Brannan St., San Francisco • Offices in Canada and Mexico

For more data circle 558 on Post Card



- breechings
- stacks
- air & gas ducts
- casings
- louvers
- bins & hoppers
- insulation jacketing
- control panels & desks

The fabrication of sheet steel and plate to exacting specifications has been a specialty of Kirk & Blum for 50 years. Exceptional experience and complete facilities for fabricating carbon steel, stainless, aluminum, monel and other alloys up to ½" thickness.

Send prints for prompt quotation or write for your copy of the latest Kirk & Blum Sheet and Plate Fabrication Booklet.

Whatever your requirements in sheet and plate fabrication . . . call on KIRK & BLUM.

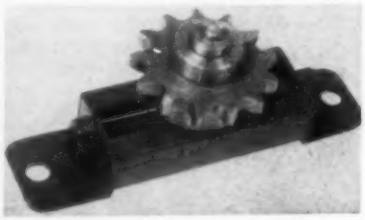
THE KIRK & BLUM MFG. CO.
3230 Forrer Street, Cincinnati 9, Ohio

For more data circle 559 on Post Card

valve immediately should a power failure occur, says manufacturer, and the valve is practically maintenance-free. This is attributed to such design features as a torque-type motor arranged to operate to a stall in both open and closed positions so that no limit switches are required; a floating bronze valve ball, hard chrome plated to resist scratching and pitting; and a resilient synthetic rubber seat, wiped clean each time the valve is opened or closed. Water turbulence and the resulting added friction loss are said to be eliminated because the full round port area does not change the water stream shape as it passes through the valve. Two standard sizes are available. Model MV-1000 is for 3-in. pipe, and Model MV-2000 is for 4-in. pipe. Bulletin A-28 gives data. Gemco Inc.

38—TIGHTENER for chain drives, comes in two sizes

Designed to smooth out roller chain drives and provide ample take-up for fixed-center and vertical chain drives, the Chain Tightener comes in two stock sizes. Incorporating a fixed shaft on a heavy lead-screw built into a welded



steel frame, this device is described as compact, sturdy and unbreakable. The adjusting screw allows fine adjustment of the chain on the slack side while the drive is operating, manufacturer states. Pressure lubrication fitting, safety set collar included. Industrial Marketers.

39—ELECTRONIC SCANNER has operational advantages

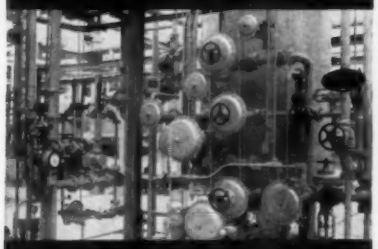
Maintenance of process stability and close reproduction of operating conditions are advantages announced for the Kybernetes Scanning System. In an initial installation, it checks several hundred thermocouples in reactor shells and on other operating equipment. This digital variable indicator and temperature monitoring system scans thermocouples at a rate of 5 per second and determines when any exceed preset common off-normal set point or a pre-set common alarm set point. If the first setting is exceeded, the time and identity of the off-normal point is recorded on an adding machine-type printer. If the second (higher) setting is exceeded, the system shuts down the plant.

This system also has a digital display panel so the thermocouple inputs can be programmed through an analog-digital system and be viewed at the panel. Digital trends may be observed at any of these points. Ability to centrally perform these functions is based on utilization of electronic comparing and analog to digital conversion circuits coupled with high reliability relay matrices for input scanning. Although designed for the petrochemical field, this scanner has application in the power, steel and other industries. Hagan Chemicals & Controls, Inc.

ILLCO-WAY ionXchange

HOW TO "AUTOMATE"

BOILER FEED WATER



WITH AN ILLCO-WAY

"POWER UNIT"

These pictures show an *Automatic* Mixed-Bed De-Ionizer designed for an outdoor installation at a power plant in Louisiana. The high-pressure boilers require feed water of uniform maximum purity — which this ILLCO-WAY "Power Unit" supplies *without attention* other than periodic checks of recording instruments. ILLCO-WAY "Power Units" are shipped *completely assembled*, ready for installation and hook-up.

REMOVES SILICA AND CO_2

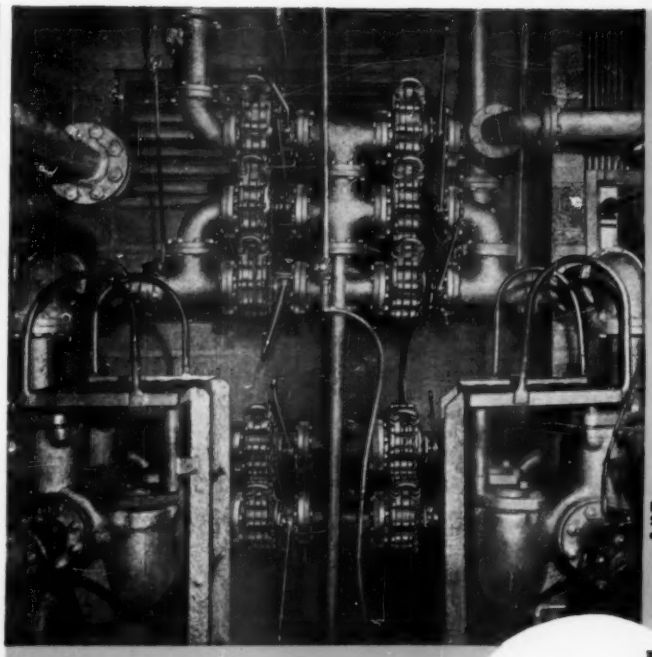
The Mixed-Bed IonXchanger, as designed and manufactured by Illinois Water Treatment Company, is often the most economical and most reliable means for treating *any kind* of supply water to obtain the maximum purity required by modern power plants. *See your ILLCO-WAY representative for details on specific applications.*

U.S. PATENTS: 2,771,424 2,605,064

ILLCO-WAY | ILLINOIS WATER TREATMENT CO. 840 Cedar St. Rockford, Ill.

NEW YORK OFFICE: 141 E. 44th St., New York 17, N.Y.
CANADIAN DIST.: Pumps & Softeners, Ltd., London, Can.

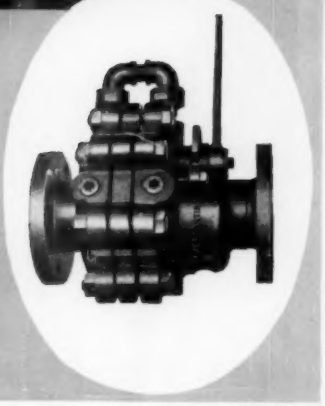
For more data circle 560 on Post Card



EVERLASTING Steam Jacketed Valves on manifolds handling tar products.

Jacketed Valves

that keep
Viscous Materials
flowing freely



for
coal tar products, asphalt, pitch, resins, varnish, waxes, paraffin, molten sulfur, etc.

Note these features:

Extra-large jacket space
Straight-through flow
Drop-tight seal
Non-wedging discs
Quick-acting lever

Write for descriptive bulletin and our 60-day free trial offer.

For "everlasting" service, use

EVERLASTING Valves

EVERLASTING VALVE CO.
47 FISK STREET, JERSEY CITY 5, N. J.

EV 304

For more data circle 561 on Post Card

HERE'S YOUR *Complete* STEAM PLANT

FEATURES of the **SUPERIOR** "COMPACT"

- One purchase, backed by undivided responsibility.
- Shipped completely assembled after factory tests to assure highest operating efficiency.
- More than 80% thermal efficiency guaranteed.
- 4-pass design provides 5 sq. ft. of heating surface per b.h.p.
- Induced draft fans which are built-in eliminate the need of an expensive chimney.
- Simple installation requires no special foundation.
- Clean, quiet operation.
- Heavy-duty, rugged construction assures long-lived dependability.
- Burner equipment to suit your fuel: gas, oil or both.
- Capacities from 20 to 300 b.h.p. for pressures up to 250 p.s.i., or for hot water heating.

For complete details on the Superior "COMPACT", write for bulletin 1006C. For details on larger size units for capacities to 600bhp., write for bulletin 1006F.

Specialists in PACKAGED BOILERS... exclusively

SUPERIOR COMBUSTION INDUSTRIES INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 36, N.Y.

SUPERIOR PACKAGED BOILERS

For more data circle 562 on Post Card

CATALOG LIBRARY

Standard catalogs listed monthly to help you maintain a reference library. To order, use the post card at right.

BOILERS, GENERATORS

201 Fire Tube Boilers — This 12-pp catalog describes Superior Compact packaged boilers in capacities from 20 to 200 bhp. Interesting arrangement of text, illustration and color is used to explain many features of the units. Gives complete data for boilers for firing oil or gas or both. Superior Combustion Industries, Inc.

202 Package Boilers — This 12-pp booklet on package steam generators describes the formulas behind all package steam generators, and illustrates how installation of a package steam generator can raise steam capacity in an existing boiler room. Cyclotherm Div., National-U. S. Radiator Corp.

204 Packaged Steam Generator — Advantages of company's baffleless, pressurized two-drum water tube packaged units are detailed in 12-pp Catalog SB-59. Features of the completely integrated generating plant, which requires no field piping, wiring, brickwork or special foundation, shown. Erie City Iron Works.

205 Packaged Steam Generator — This bulletin describes company's type DK packaged water tube steam generator available in units from 6000 to 60,000 lbs. of steam per hour and design pressures from 200 to 600 psi. Gives features, size and capacity of these boilers. E. Keeler Co.

207 Steam Generators — Twelve-pp Bulletin PSG-2 contains design and construction details on company's package unit steam generator — a vertical, bent tube, longitudinally fired water tube boiler. Capacities, dimensions and weights are tabulated. Henry Vogt Machine Co.

209 Integral-Furnace Unit — Bulletin G-94 describes the Type PFI integral-furnace boiler, a pressurized-furnace oil- and gas-fired steam generator for power, process or heating loads requiring steam capacities to 400,000 lb-hr. at pressures to 1150 psi and temperatures to 900 F. The Babcock & Wilcox Co.

210 Low Pressure Heating Plant — Guide specifications for typical low-pressure commercial heating plants are presented in this 35-pp publication. Scope of guide specifications and basis of recommendations are detailed, and an index to specifications is given. Tabulated data are included along with drawings of typical boiler room, over fire air system, and stacks. Bituminous Coal Institute.

FUEL BURNING EQUIPMENT

211 For Burning Refuse Fuel — This 8-pp bulletin describes refuse fuel burning equipment, including a pneumatic refuse fuel distributor which spreads refuse fuels such as bark, wood chips, and bagasse uniformly over the grate surface. Discusses components. Riley Stoker Corp.

212 Oil and Gas Burners — Bulletin OB-53, 28 pp, gives principles of selection and application of oil or gas burners,

DECEMBER, 1958

NOTE: Card void after March 31, 1959

POWER ENGINEERING

Please have the manufacturers send me without obligation information or bulletins indicated by the numbers circled below.

Name.....Title.....

Company Name.....
(Must be included)

Company Address.....

City.....State.....
(If you prefer delivery at home, give home address, too)

Home Address.....

City.....State.....

Helpful Bulletins

1	2	3	4	101	102	103	104	105	106	107
5	6	7	8	108	109	110	111	112	113	114
9	10	11	12	115	116	117	118	119	120	121
13	14	15	16	122	123	124	125	126	127	128
17	18	19	20	129	130	131	132	133	134	135
21	22	23	24	136	137	138	139	140	141	142
25	26	27	28	143	144	145	146	147	148	149
29	30	31	32	150	151	152	153	154	155	156
33	34	35	36	157	158	159	160	161	162	163
37	38	39	40	164	165	166	167	168	169	170
41	42	43	44	171	172	173	174	175	176	177

Equipment

501	502	503	504	505	506	507	508	509	510	511
522	523	524	525	526	527	528	529	530	531	532
543	544	545	546	547	548	549	550	551	552	553
564	565	566	567	568	569	570	571	572	573	574
585	586	587	588	589	590	591	592	593	594	595

Catalog Library

201	202	203	204	205	206	207	208	209	210	211
212	213	214	215	216	217	218	219	220	221	222
223	224	225	226	227	228	229	230	231	232	233
234	235	236	237	238	239	240	241	242	243	244
245	246	247	248	249	250	251	252	253	254	255
256	257	258	259	260	261	262	263	264	265	266
267	268	269	270	271	272	273	274	275	276	277
278	279	280	281	282	283	284	285	286	287	288
289	290	291	292	293	294	295	296	297	298	299

Advertised Products and Services

501	502	503	504	505	506	507	508	509	510	511
522	523	524	525	526	527	528	529	530	531	532
543	544	545	546	547	548	549	550	551	552	553
564	565	566	567	568	569	570	571	572	573	574
585	586	587	588	589	590	591	592	593	594	595
512	513	514	515	516	517	518	519	520	521	
533	534	535	536	537	538	539	540	541	542	
554	555	556	557	558	559	560	561	562	563	
575	576	577	578	579	580	581	582	583	584	
596	597	598	599	600	601	602	603	604	605	

Use this space to ask for free ..... sheets and other information. .....

BUSINESS REPLY MAIL
No Postage Stamp Necessary if Mailed in United States

POSTAGE WILL BE PAID BY —

POWER ENGINEERING

308 East James St.

BARRINGTON, ILLINOIS

FIRST CLASS
PERMIT No. 11
Sec. 34.9 P.L.&R.
BARRINGTON, ILL.

or a combination of both for standard and wide capacity range operation, together with air registers and fuel oil heating and pumping sets. Conversion table shows approximate relationships between quantity of oil burned, boiler capacity and air required for combustion. The Engineer Co.

213 Pumping, Heating Units — Featured in 16-pp Bulletin 40 is a line of fuel oil pumping and heating units for preparing heavy fuel oil for combustion in all types of oil burners. Various types of industrial applications are illustrated, and ratings, specifications, a diagrammatic view of fuel oil pumping and heating unit, given. National Airoil Burner Co., Inc.

TUBING AND ACCESSORIES

214 Heat Exchanger Tubing — Cited in 30-pp Catalog A-205 are typical cases where cupro-nickel or Monel tubing installed in heat exchangers resulted in substantial savings and better efficiency through longer tube life. Describes applications of this tubing in various instances where unusual water conditions required it. The International Nickel Co., Inc.

215 Tubes and Plates — Publication B-2, 46 pp, covers the subject of tubes and plates for condensers and heat exchangers. Fields of application and particular problems encountered in each are described. Information on condenser tube alloys, plates for tube sheets and baffles, manufacturing methods, installation, operational factors affecting tube life, corrosion factors in condenser tube service is presented. The American Brass Co.

217 Tube Cleaners—Bulletin G-515 describes company's line of air, steam and water driven tube cleaners and accessories. Photos of the various types of cleaners are included, along with descriptive details and specification data. Elliott Co. — Roto Plant, Div., Carrier Corp.

218 Life Extension for Condenser Tubes — The 32-pp current edition of this booklet reports on research into the causes of corrosion and means of combating them, as well as the choice of condenser tube materials. Points out that Admiralty metal, long a standard for power plant condenser tubes, works satisfactorily in most installations, but other alloys may be necessary in others. Revere Copper and Brass, Inc.

COAL AND ASH HANDLING

220 Improved Crushers — Bulletin 12-C, 16-pp, describes company's line of crushers for reducing coal, coke, glass cullet, gypsum, lime, metal turning, sugar, sulphur and similar lump materials. Covers Knitted ring type crushers, two-stage double-roll crushers, single-roll crushers, and double-roll crushers. Photos, sizes included. Stephens-Adamson Mfg. Co.

222 Shredders, Crushers — Bulletin 257 describes and illustrates hammermills and shredders, rolling ring and special crushers for reducing chemicals, minerals, ceramics, and other materials including wood waste. Discusses construction features of the line and includes dimensions. American Pulverizer Co.

224 Why Stainless-Clad Steel — Advantages of stainless-clad steel for coal handling equipment are detailed in this 16-pp bulletin. Photo-stories of typical applications in hoppers, chutes, bunker noses, included. Lukens Steel Co.

WATER CONDITIONING

226 Boiler Water Treatment — Chemical reduction of oxygen in boiler feedwater with hydrazine is the subject of

DECEMBER, 1958

NOTE: Card void after March 31, 1959

POWER ENGINEERING

Please have the manufacturers send me without obligation information or bulletins indicated by the numbers circled below.

Name.....Title.....

Company Name.....
(Must be included)

Company Address.....

City.....State.....
(If you prefer delivery at home, give home address, too)

Home Address.....

City.....State.....

Use this space to ask for tear sheets and other information.

.....

.....

Helpful Bulletins

Equipment								
1	2	3	4	101	102	103	104	105	106	107
5	6	7	8	108	109	110	111	112	113	114
9	10	11	12	115	116	117	118	119	120	121
13	14	15	16	122	123	124	125	126	127	128
17	18	19	20	129	130	131	132	133	134	135
21	22	23	24	136	137	138	139	140	141	142
25	26	27	28	143	144	145	146	147	148	149
29	30	31	32	150	151	152	153	154	155	156
33	34	35	36	157	158	159	160	161	162	163
37	38	39	40	164	165	166	167	168	169	170
41	42	43	44	171	172	173	174	175	176	177

Catalog Library

201	202	203	204	205	206	207	208	209	210	211
212	213	214	215	216	217	218	219	220	221	222
223	224	225	226	227	228	229	230	231	232	233
234	235	236	237	238	239	240	241	242	243	244
245	246	247	248	249	250	251	252	253	254	255
256	257	258	259	260	261	262	263	264	265	266
267	268	269	270	271	272	273	274	275	276	277
278	279	280	281	282	283	284	285	286	287	288
289	290	291	292	293	294	295	296	297	298	299

Advertised Products and Services

501	502	503	504	505	506	507	508	509	510	511
522	523	524	525	526	527	528	529	530	531	532
543	544	545	546	547	548	549	550	551	552	553
564	565	566	567	568	569	570	571	572	573	574
585	586	587	588	589	590	591	592	593	594	595

512	513	514	515	516	517	518	519	520	521
533	534	535	536	537	538	539	540	541	542
554	555	556	557	558	559	560	561	562	563
575	576	577	578	579	580	581	582	583	584
596	597	598	599	600	601	602	603	604	605

BUSINESS REPLY MAIL
No Postage Stamp Necessary If Mailed in the United States

POSTAGE WILL BE PAID BY—

POWER ENGINEERING

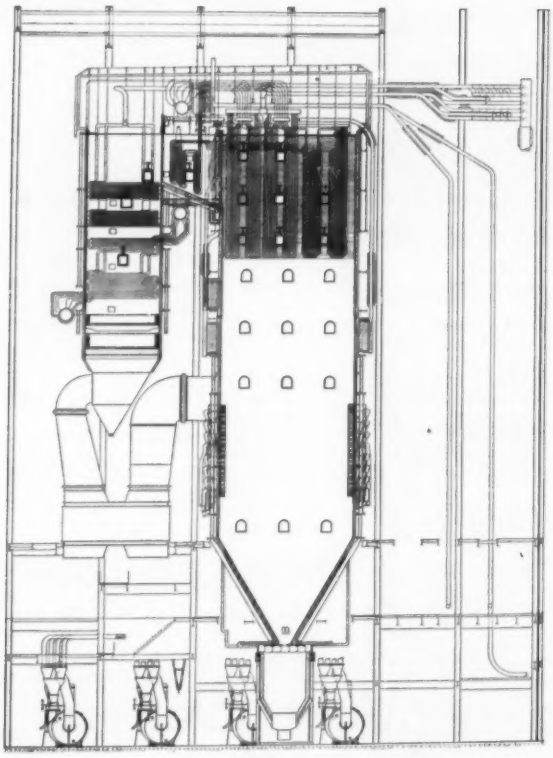
308 East James St.

BARRINGTON, ILLINOIS

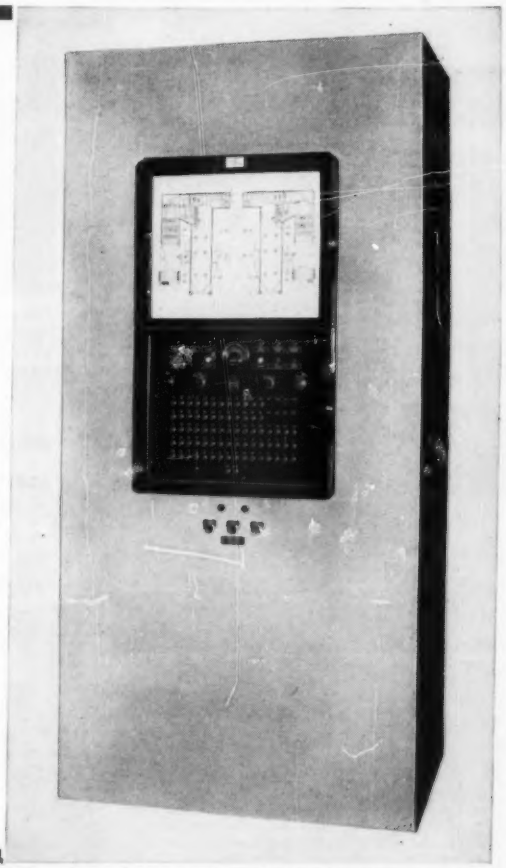
FIRST CLASS
PERMIT No. 11
Sec. 34.9 P.L.&R.
BARRINGTON, ILL.

COPES VULCAN | BLAW-KNOX

How Copes-Vulcan control systems boost power plant efficiency



Showcase super-critical steam generator will be equipped with a Selective-Sequence System that includes Vulcan T-30 long retractables with 30 to 37-foot travels, half 'tracts with 19-foot travels. Wall deslaggers and air-preheater cleaner controls will also be used.



Nerve center for precision boiler cleaning, the SSC-120 Selective-Sequence Controller is pre-wired and factory assembled for positive control. It handles up to four cycles for each blower. A 60-station model is also available.

Vulcan soot blowing system saves steam, air and manpower

A Vulcan Selective-Sequence System gives the operator the ultimate in finger tip control of *individual* soot blowers. He can set up a sequence to assure thorough boiler cleaning and forget it. He can monitor the program at a glance, stop it, restart it or change any soot blower from any point in the sequence to another to improve cleaning or conserve the blowing medium. Here's complete flexibility without extensive time consuming wiring and piping changes.

Besides Selective-Sequence, Vulcan also builds Automatic-Sequential Systems that can use steam and/or air without a change in equipment, and can provide both simple automatic or manual control.

A complete line . . . a complete service

Over 50 years of design experience backs Copes-Vulcan's broad line of control systems for boiler cleaning, combustion, feed water, pressure reducing and desuperheating.

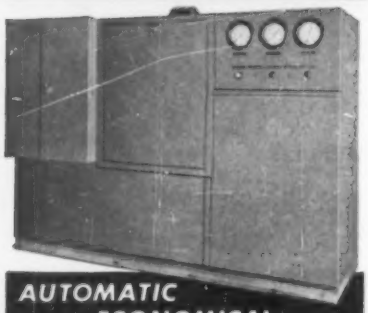
Whether furnished in individual units or integrated into a single system, each installation gets custom design, skilled continuing service. Trained service men help set up a routine inspection-maintenance program . . . visit each installation periodically.

Bulletin 1029 details Vulcan Automatic Soot Blowing Systems. Write for your copy today.

Copes-Vulcan Division
BLAW-KNOX COMPANY
Erie 4, Pennsylvania

For more data circle 563 on Post Card

NOW-Steam Atomizing WITH NATIONAL AIROIL Packaged Firing Units FOR OIL AND/OR GAS FUELS



AUTOMATIC
ECONOMICAL
CLEAN . . . SAFE

- Fully Automatic
- Low Fire Start
- Electric-gas Ignition
- Modulating Fire Control
- Damper Sequence Control
- Forced Draft Combustion Air
- Electronic Combustion Safety Supervision
- Mechanical Atomizing—Steam assisted internal mixing oil burner
- Ring or Cylindrical type Gas Burner for gas fuel
- Fire tested before shipment.

NOW . . . with the new Series 20 Packaged Firing Unit you can have all the advantages of the outstanding Dual Stage burner in a completely packaged unit equipped with the latest in electronic safety controls to give *automatic* start, *automatic* modulation, *automatic* shutdown.

Series 20 Packaged Firing Units are factory fire tested, ready for immediate and low cost installation in your furnace room. They need only oil, gas, steam, draft and electrical connections—everything else needed for fully automatic burner operation is there.

Capacities of standard units range from 200 to 830 boiler horsepower. (7,200 to 30,000 pounds of steam per hour). Larger units are available on order to meet your special needs.

Units may be used with any standard boiler or furnace under natural or induced draft, or with pressurized boilers—in which case the unit provides sufficient forced draft to overcome draft loss through boiler. Where a high chimney or induced draft fan is used, an automatic damper motor is furnished to provide a constant furnace draft during operations; and a reduced or zero draft during shutdowns.

Preventative Maintenance consists chiefly of keeping the burner gun clean, with periodic inspection and cleaning of strainers and safety devices. This minimum maintenance will give your engineer or fireman extra time to attend to blow-down, soot-blowing, or to check operations and efficiency of plant and auxiliary equipment.

For complete details, specifications, illustrations, and dimensions write today for Bulletin No. 28.

When used in conjunction with a National Airoil Fuel Oil Pumping and Heating Unit (Bulletin No. 40) a most reliable combination results.

NATIONAL AIR OIL BURNER COMPANY, INC.

1268 E. Sedgley Ave., Philadelphia 34, Pa.
S. W. Division: 2512 So. Blvd. Houston 6, Texas

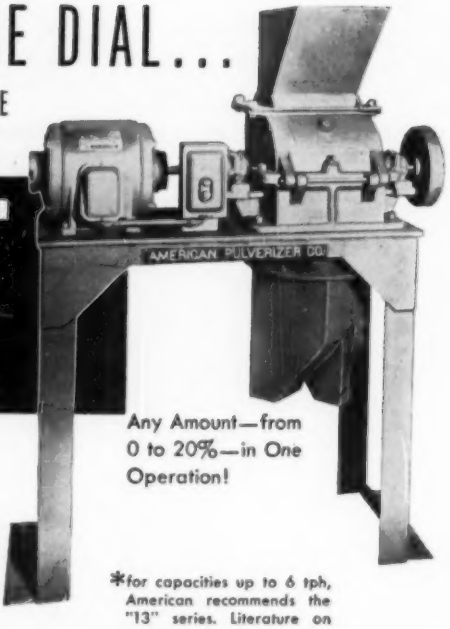
For more data circle 564 on Post Card

JUST SET THE DIAL...

FOR A REPRESENTATIVE SAMPLE OF A SAMPLE

AMERICAN SAMPLE CRUSHER

WITH NEW ADJUSTABLE SAMPLING HOPPER



Does the job so quickly, efficiently, there's no loss of moisture content in sample.

FAST Up to 1 tph (Model 15 x 9); ½ tph for Model 9x9 (shown).*

EFFICIENT Once-through and the job's done!

LOW COST Practically no wear to an American Sample Crusher.

Any Amount—from 0 to 20%—in One Operation!

*for capacities up to 6 tph, American recommends the "13" series. Literature on request.

American PULVERIZER COMPANY

Engineers and Manufacturers of Ring Crushers and Pulverizers

1431 MACKLIND AVE., ST. LOUIS, MO.

For more data circle 565 on Post Card

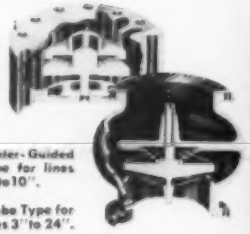
for Connecticut General

safe silent

PIPING SYSTEMS

This dramatic new office for Connecticut General Life Insurance Co. in Hartford is another major structure that is well-protected against surge pressures and water hammer by Williams-Hager Silent Check Valves.

Write for Bulletins: No. 654 on Valves; No. 851 on Cause, Effect and Control of Water Hammer



Center-Guided Type for lines 1" to 10".

Globe Type for lines 3" to 24".

WILLIAMS·HAGER
Silent
CHECK VALVES

Architect: . . . Skidmore, Owings and Merrill
Consulting Engineer: Syska & Hennessy, Inc.
General Contractor: Turner Construction Co.
Plumbing Contractor: C. H. Cronin Inc. Heating and Ventilating Contractor: Kerby Saunders.

THE WILLIAMS GAUGE CO., Inc.

143 Stanwix St. • 2 Gateway Center • Pittsburgh 22, Pa.

Our 72nd Year • 1886-1958

For more data circle 566 on Post Card

10-pp Bulletin BW-7. Economy and operation, handling of the Deoxy-Sol, methods of analysis and other details are covered. Fairmont Chemical Co., Inc.

228 Water Treatment Equipment — An outline of modern water treatment equipment is presented in this 10-pp Bulletin 4433. Discusses water impurities and methods of treatment, typical water-treatment systems, aerators, degasifiers, deaerators, chemical feeders, precipitation equipment, filters, and ion exchange equipment. The Permutit Co.

230 Feedwater Treatment — Process Bulletin B1, "Treatment of Boiler Feedwater by Direct, or Internal Method," discusses advantages of direct treatment, as a complete treating program or as a supplement to external systems. Explains why direct treatment is convenient, economical. National Aluminate Corp.

231 Mixed-Bed De-Ionizers — Practical equipment for mixed-beh de-ionization of flow rates of 5 gph to 5000 gpm is described in this 8-pp bulletin. Advantages of construction and design are detailed, as well as mechanical features, installation operation. Illinois Water Treatment Co.

233 Consulting Service — Advantages of company's consulting service are detailed in 8-pp Bulletin 5006-A. How the service is qualified to solve problems concerning scale and corrosion control in boilers, cooling systems, and process waters is discussed. Dearborn Chemical Co.

235 Anti-Foam Agent — A cure for carryover of boiler water due to foaming is described in this illustrated brochure on Concentrol — a surface active agent of the polyalkylene glycol group. Before and after photos illustrate performance characteristics in test case. The Bird-Archer Co.

REFRACTORIES, INSULATIONS

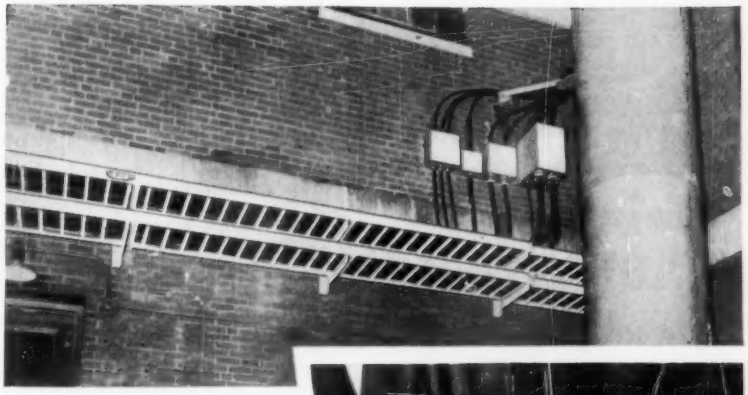
237 Refractory Castable — Bulletin R-40 describes the use of Kaocrete, company's refractory castable, in boiler ashpits. A discussion of the various methods of ash removal, along with the maintenance problems peculiar to each, is presented. Four installations detailed. Refractories Div., The Babcock & Wilcox Co.

238 Refractory Mortar — This is a 24-pp manual covering the use of Lumnite calcium-alumininate cement as a mortar mix for gun-applied linings in power plant, refinery and metalworking equipment. Includes data on mortar preparation, placing procedures, curing: also general instructions. Universal Atlas Cement Co.

239 Industrial Insulations — Thermal, mechanical, physical, and chemical characteristics of company's industrial insulations are presented in 20-pp Catalog J-424. Includes data on high temperature spun-mineral wool insulating block, blankets, pipe coverings and cements and on mineral wool industrial felts and duct insulation. Baldwin-Hill Co.

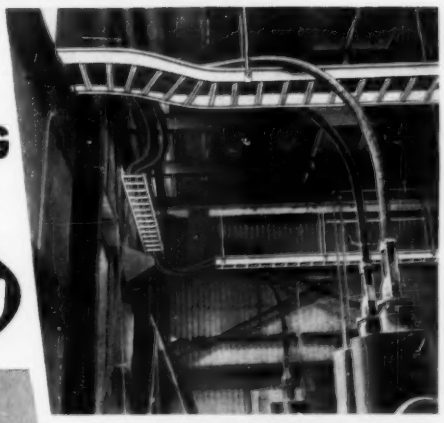
HEATING

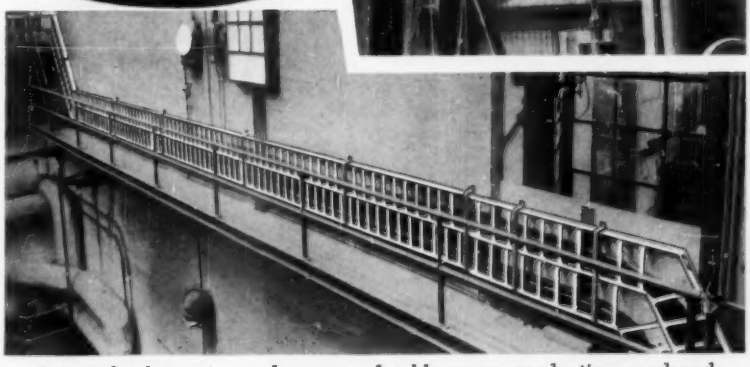
241 Electric Heating Units—Catalog 50, 50 pp, contains complete engineering data on electrical heating units and equipment, including strip elements, finstrip elements, tubular elements, cartridge elements, ring elements, immersion heaters, circulation heaters, radiant heaters, forced air duct heaters, unit heaters, hot plates. Edwin L. Wiegand Co.



a new, superior system of CABLE and TUBING RACE WAYS...

Globetray PAT. PENDING



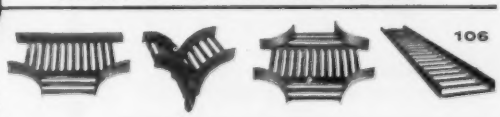


A completely engineered system of cable ways, production produced and die formed for uniformity with up to twice the strength of ordinary trays, by actual laboratory tests. The universal splice plate joins all parts through the side channels only. All curved fittings are joined at the end of the radius (no tangent material is required) permitting continuous curves. This feature provides greater flexibility of application in tight places and creates an endless variety of combinations for a simple solution to any design problem of change of direction or elevation with a complete set of standard fittings.

Comes in 6", 12", 18" and 24" widths, in standard 12' lengths to further speed up installation time. Cable way can be cut to length at any point—insides and bottom always smooth—all sections punched for easy installation—perfect fit at all times. Neat, clean and uniform in appearance.

Globetray THE GLOBE COMPANY

EASY TO INSTALL • SAVES TIME • SAVES ON MATERIAL
GALVANIZED • NO MAINTENANCE PROBLEM



Write for new complete catalog. Distributors in all principal cities. Contact the Grip-Strut distributor under "Conduits" in the classified telephone directory.

PRODUCTS DIVISION The GLOBE Company
4022 S. PRINCETON AVE. • CHICAGO 9, ILL.

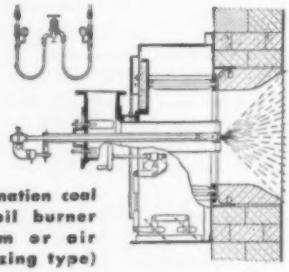
For more data circle 567 on Post Card

Enco
OIL BURNERS
have these
7 ADVANTAGES
in pulverized coal
fired boilers . . .

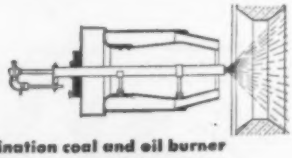
They may be installed in practically all types of pulverized coal burners, with these seven important advantages:

- They warm up cold furnaces
- They ignite pulverized coal—safely
- They assure continuous operation in case coal system fails
- They provide efficient and safe operation on bank and at low loads
- They respond almost instantly to sudden load changes
- They permit operation with oil or coal—whichever is available and lowest in cost per BTU.
- All capacities of steam, air or mechanical-atomizing types are interchangeable

The foregoing are only a few of the reasons why Enco oil-burners have been bought by a long list of leading industrial firms. Details of how Enco oil-burners can be adapted to your present pulverized coal burners will be gladly supplied—without obligation. Write The Engineer Company, 75 West St., New York, N. Y.



Combination coal and oil burner (Steam or air atomizing type)



Combination coal and oil burner (Mechanical atomizing type)

Enco Burners

ELECTRICAL EQUIPMENT

243 Handbook on Fuses — This 12-pp booklet contains practical information on how to get safe, dependable, trouble-free electrical protection. Shows what to do when fuses blow, how to determine cause of blows, what kind of fuse to use for various circuits. Contains short history of fuses. Bussmann Mfg. Div.

244 Cable Troughs — This 28-pp catalog offers a simple solution to any design problem of change of direction or elevation with a complete set of standard fittings, horizontal elbows, inside and outside vertical elbows, ties, crosses, covers and special devices. The Globe Co.

245 Electrical Enclosures — Bulletin EE, 14 pp, describes company's line of sheet metal electrical enclosures and other related items for a variety of applications. Covers control desks, electrical cabinets and enclosures, power distribution and control panels, boiler, turbine generator control panels, switchgear housings, and others. The Kirk & Blum Mfg. Co.

246 Testing Instruments—Bulletin 19-58, 16 pp, features company's electrical testing instruments, including ohmmeters, ground testers, dielectric test sets, motor rotation tester, cable fault locating equipment, transformer turn ratio test sets, corona test equipment, frequency meters, tachometers, others. Includes photos. James G. Biddle Co.

MECHANICAL POWER TRANSMISSION

247 Self-Aligning Coupling—Featured in this illustrated bulletin are company's self-aligning forged steel couplings designed to transmit maximum torque indefinitely. A cutaway view showing component features and tables of ratings are included. Koppers Co., Inc.

248 Controlled Speed Systems — Eight-pp Booklet F-1952 describes typical installations for controlled automatic variable speed systems, including control of liquid level, pressure, rewind tension, speed sensitivity, load, position or link synchronization, temperature, multiple drive conveyors. U. S. Electrical Motors Inc.

250 Shaft-Mounted Reducers—Bulletin A-637A, 28-pp, describes complete line of Torque-Arm speed reducers, available in single and double reduction units capable of delivering up to 100 hp at 100 rpm. Product photographs, installation pictures, engineering drawings and selection tables included. Dodge Mfg. Corp.

INSTRUMENTS AND CONTROLS

252 Guide to Gages—Catalog 300-B, 112 pp, features Ashcroft Duragauges, Maxisafe, pneumatic receiver, recording, quality, drawn case, chemical and special application gages. Also presented are gage testers, pneumatic transmitters, gages for nuclear energy. Engineering data and charts are provided. Instruments shown cover dial sizes from 2 through 24 in. Manning, Maxwell & Moore, Inc.

253 Metering, Control Systems — Bulletin 500 describes purpose, design and operation of company's metering and control systems. Includes discussion of pneumatic and electric telemetering and pneumatic control. Bailey Meter Co.

254 Ring Balance Meters — Specification Sheet PM-10002 features a line of ring balance meters designed to convert fluid differential pressure measurements into flow records and indications. Includes description of operation, specifications. Hagan Chemicals & Controls, Inc.

255 Bi-Color Gage — Bulletin 2044 describes advantages of the Multi-Port bi-color gage developed to eliminate common gage troubles encountered in low and medium pressure ranges. Design features shown. Diamond Power Specialty Corp.

256 For Feedwater Analysis — Bulletin 148BP contains a technical discussion of manufacturer's analyzers for determination of dissolved oxygen and hydrogen in feedwater. Discusses both O and H units as to function, ranges, accuracy. Cambridge Instrument Co., Inc.

258 Cut-Outs and Alarms — Brochure D2 describes electrode type equipment for installation on water columns to provide fuel cut-out, high and low water level alarms and pump cut on and off. Reliance Gauge Column Co.

260 Ideas on Push-Pull Controls — Included in this "Idea File" are answers to a power engineer's questions on the use of push-pull controls. A general information booklet discusses remote control applications, explains construction and operation of company's Tru-Lay controls. Separate bulletins are devoted to standard assemblies, bracket-type head controls. Automotive and Aircraft Div., American Chain & Cable Co., Inc.

PUMPS AND COMPRESSORS

262 Controlled Volume Pumps — Bulletin 953, 24 pp, describes and illustrates use of controlled volume pumps in

What's the low-down on blow-down?

The whole story will probably surprise you. It is true, for example, that about 90% of all boiler blow-down today is still hit-or-miss. It's also true that equipment to do the job right can save enough wasted heat units to pay its own way in a matter of months. To get all the eye-opening facts send a card, letter or wire to *The Madden Corp., 1345 Jarvis Ave., Chicago 26, Ill.*, and ask for "Blow-down Low-down."

DEOXY-SOL
SOLUTION OF HYDRAZINE

- Oxygen-
- Scavenger
- for
- Boiler Water
- Treatment

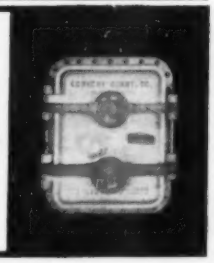
FAIRMOUNT
CHEMICAL CO., INC.
136 Liberty St., New York 6, N.Y.

Midwestern Representative:
J. H. Delamar & Son, Inc.
4529 No. Kedzie Avenue
Chicago 25, Ill.

Ask for pamphlet BW-7

For more data circle 570 on Post Card

HIGH PRESSURE CLEAN OUT DOORS



- Asbestos-Packed Cast Iron Construction
- Double Crossbar, Hinge and Handwheel Design
- Right or Left Hinge
- Available with Double Locking Device to prevent accidental locking from outside only
- Assures Maximum Strength, Efficiency and Economy for every High Pressure Application

IMMEDIATE DELIVERY IN SIZES FROM 15" x 18" to 24" x 36"

FROM $95.00 to $275.00 each

CONNERY
CONSTRUCTION COMPANY
STEEL PLATE CONSTRUCTION
2nd and Luzerne Sts.
P. O. Box 4437, Philadelphia 40, Pa.

For more data circle 571 on Post Card

industrial water treating systems. Construction and operation features are described, capacity-pressure ranges and speed and stroke length adjustments are charted. Typical chemical feed and water testing systems are presented through text and diagrams. Milton Roy Co.

263 Flow Control — Twelve-pp Catalog 801 describes four basic models of precision proportioning pumps for uses requiring accurate and positive proportioning of flow in range of 0 to 730 gph. Materials of construction, capacities and pressures are shown for each. Diaphragm valves are discussed and their features noted. Hills-McCanna Co.

264 Low Pressure Compressors — Eight-pp Bulletin A-95 describes a line of low pressure compressors for heavy duty industrial applications. Engineering design features are detailed and advantages explained. Joy Mfg. Co.

PACKINGS, GASKETS, SEALS

266 Mechanical Packings—Featured in 24-pp Catalog 56 are several recent packing developments including the multi-purpose Bel-Vee V-Ring packings, the long wearing criss-cross braid packing series, twisted foil packings for oil and distillate temperatures to 1000 F, and an Inconel-wire reinforced plastic packing for valves handling superheated steam. The Belmont Packing & Rubber Co.

267 Gaskets and O-Rings — Gaskets, back-up rings and O-rings impervious to acids, alkalis, corrosives and solvents at temperatures from −120 to 500 F are described in 6-pp Bulletin P-327. Information includes service and mechanical recommendations, data on operating pressures and standard sizes. Crane Packing Co.

OTHER EQUIPMENT

268 Lubricants — Specification, Classification — Vital information on selection of lubricants is presented in 10-pp Vol. 41, No. 4 of "Lubrication." Covers such items as performance specifications, initial suitability of lubricants, quality of lubricant, effect of lubricant on production; effect on maintenance, effect on power, effect on cost, and features a look to the future. The Texas Co.

269 Better Fuel Performance — This bulletin describes two of company's products designed for better fuel performance and economy. The first is a fuel oil sludge dispersant which prevents sludge and moisture separation in heavy fuel oil. The other is a soot remover. Western Chemical Co.

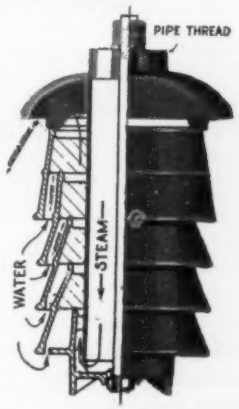
270 Lithium Greases — This product information bulletin presents manufacturer's six Litholine industrial greases, stressing industry advantages offered by these multi-purpose greases. Gives properties of the greases, general application and performance characteristics and includes test data. Sinclair Refining Co.

271 Versatile Industrial Oil — Described in 20-pp Form AD 4078 is an all-purpose oil offering protection for a wide range of industrial equipment, and available in 15 viscosity grades. Discusses six major characteristics of the oil; explains and pictures its use in hydraulic systems, speed reducers, air compressors, electric motors, hydraulic turbines, bearing systems, etc. A chart shows grades available, uses, properties. Standard Oil Co. (Ind.)

Quiet
PERFORMANCE
with
SIMS
HUSHEATERS
NO VIBRATION

Always in hot water but never complains!

Now you can inject Live Steam into liquids in processing plants, boiler feed hot wells or elsewhere without nerve-shattering noise and tank-wrecking vibration.



The Sims HusHeater:

• Conserves maximum heat in available steam. • Heats liquids efficiently. • Eliminates burning and discoloration of liquid in process. • Reduces burden on heater. • Reduces back-pressure on auxiliaries. • Increases temperature of feed water to the boilers. • Saves Steam.

Steam flows down thru the center tube, and up thru converging nozzles. The high velocity sucks the liquid in to mixing chamber along the hot center tube. No moving parts.

Sims
PUMP VALVE CO., INC.
1314 Park Avenue Hoboken, N.J.
(N.J.) SWarthmore 2-0600 (N.Y.) BArclay 7-7661
CABLE: SIMSVALV HobokenNJ

For more data circle 572 on Post Card

ADVERTISERS' INDEX

Aerovent Fan Co., Inc. 127
Air Preheater Corp., Inc. 40
Airetool Mfg. Co., The ..... *
American Brass Co. 55
American Chain & Cable Co. Automotive & Aircraft Div. 113
American Gilsonite Co. ..... *
American Hard Rubber Company 112
American Pulverizer Co. 122
Anderson Co., V. D. ..... *
Armstrong Machine Works 7, 128
Associated Research, Inc. ..... *
Aurora Pump Division The New York Air Brake Co. ..... *
Automotive & Aircraft Div. American Chain & Cable Co. 113

Babbitt Steam Specialty Co. ..... *
Babcock & Wilcox Co., The (Boiler Div.) 38-39
Babcock & Wilcox Co., The (Refractories Div.) 2
Bailey Meter Company ..... Cover II
Baldwin-Hill Co. 29
Baltimore & Ohio RR. ..... *
Barco Manufacturing Co. ..... *
Belmont Packing & Rubber Co., The 110
Betz Laboratories, Inc. 97
Biddle Co., James G. ..... *
Bigelow Company, The ..... *
Bird-Archer Co., The 115
Bituminous Coal Institute 22-23
Buffalo Forge Company ..... *
Bussmann Mfg. Co. 12-13
Byron Jackson Pumps, Inc. ..... *

Cambridge Instrument Co., Inc. 127
Chapman Valve Mfg. Co., The 18-19
Childers Mfg. Co. ..... *
Cleaver-Brooks Co. ..... *
Clyde Iron Works, Inc. 63
Cochrane Corporation ..... *
Combustion Engineering, Inc. 20-21
Connery Construction Corp. 125
Copes-Vulcan Div., Blaw-Knox Co. 121
Crane Co. 105
Crane Packing Co. 28
Curtiss-Wright Corp. ..... *
Cyclotherm Div. National-U. S. Radiator Corp. 64

Davis Engineering 114
Dearborn Chemical Co. ..... *
De Laval Steam Turbine Co. 5
Detroit Stoker Company ..... *
Diamond Power Specialty Corp. 101
Dodge Manufacturing Co. 65
du Pont de Nemours & Co., E. I. ..... *

Edward Valves, Inc. 10-11
Elliott Co. ..... *
Ellison Draft Gage Co. ..... *
Engineer Co., The 124
Erie City Iron Works 14-15
Everlasting Valve Co. 117

Fairmount Chemical Co., Inc. 125
Felt Products Mfg. Co. ..... *
Flexonics Corp. ..... *
Foster Wheeler Corp. ..... *
Fuller Co. 54

General Coal Co. 128
General Electric Co. ..... *
Globe Co., Products Div. 123
Goodall Rubber Co. ..... *
Graver Water Conditioning ..... *
Gray Pantograph Engraving Co. ..... *
Gruendler Crushers & Pulverizer Co. ..... *

Hagan Chemicals & Controls, Inc. ..... *
Hall Laboratories ..... *
Hills-McCanna Co. 67

Illinois Water Treatment Co. 117
International Nickel Co., Inc., The 62

Johnson-March Corp. ..... *
Joy Mfg. Co. 66

E. Keeler Co. 61
Kewanee Boiler Division ..... *
Kirk & Blum Mfg. Co. 116
Koppers Co., Inc. 60

Lacledo Stoker Co. ..... *
Ladish Co. ..... *
Leslie Co. 109
Lukens Steel Company 27

Madden Corp. 124
Manning, Maxwell & Moore, Inc. 36
Marley Co., The 49
Maryland Shipbuilding & Drydock Co. ..... *
Mead-Morrison Division, McKiernan-Terry Corp. 99
Milton Roy Co. 81
Moore & Co., Samuel ..... *
Morton Salt Co. 24

Nagle Pumps, Inc. ..... *
National Airoil Burner Co., Inc. 122
National Aluminate Corporation ..... *
Niagara Blower Company ..... *

Ohio Injector Co. ..... *
Old Ben Coal Co. ..... *
OXI Corp. 127

Permutit Co., The 107
Pittsburgh Piping & Equipment Co. 1
Powell Valves, Wm. ..... Cover III
Praf-Daniel Corp. ..... *
Pratt Co., Henry 42

Raybestos-Manhattan, Inc. ..... *
Refractory & Insulation Corp. ..... *
Reliance Gauge Column Company 32
Republic Flow Meters Co. ..... *
Revere Copper & Brass Inc. 58-59
Ric-wil, Inc. ..... *
Riley Stoker Corporaton 56-57
Rockwell Co., W. S. ..... *
Roto Div. of Elliott Co. 30

Sarco Company, Inc. ..... *
Sims Pump Valve Co. 125
Sinclair Refining Co. 41
Socony Mobil Oil Co., Inc. 34-35
Solar Aircraft Co. 33
Spence Engineering Co. ..... *
Standard Oil Co. (Indiana) 17
Stephens-Adamson Mfg. Co. 31
Stickle Steam Specialties Co. ..... *
Stone & Webster Engineering Co. 53
Superior Combustion Industries, Inc. 118

Taylor & Co., W. A. ..... *
The Terry Steam Turbine Co. 103
Texas Co., The ..... Cover IV
Troy Engine & Machine Co. ..... *

Union Asbestos ..... *
U. S. Electrical 37
Universal Atlas Cement 16

Valley Camp Coal Co. ..... *
Van-Packer Co., Div. of ..... *
Vogt Machine Co., Henry 111

Webster Mfg. Co. ..... *
Western Chemical Company ..... *
Wickes Boiler Co. ..... *
Wiedeke Co., The Gustav ..... *
Williams Gauge Co. 122
Wilson, Inc., Thomas C. ..... *
Worthington Corporation ..... *
Wright-Austin Co. ..... *

Yarnall-Waring Company 8-9, 68

Firms whose advertising is not in this issue but is appearing in other issues are marked with an *

If you burn coal

OXI CRYSTALS

will increase boiler efficiency!

By adding OXI Crystals you get more heat and steam with less fuel, minimize smoke, insure full boiler output at all times, completely oxidize all combustible deposits from firedoor to the top of the stack . . . all this with very little labor involved.

OXI Crystals will also get rid of slag, firescale, encrusted carbon and soot in your boiler . . . *fast!*

We are so confident that OXI will satisfy you we offer it under an iron-clad guarantee.

Learn more about this amazing product. Write today for full information

Also ask about KOR, the perfect *fuel oil conditioner* . . . and SURFBLOW, the *floating boiler water skimmer.*

OXI CORPORATION
812 — Box 485
GARY, INDIANA

For more data circle 573 on Post Card

CAMBRIDGE GAS ANALYZERS

at the
23rd NATIONAL POWER SHOW
BOOTHS 471–473

COMBINATION DISSOLVED OXYGEN AND DISSOLVED HYDROGEN ANALYZER, to record oxygen dissolved in boiler feedwater and hydrogen in steam condensate. Bulletin 201

COMBINATION OXYGEN, CARBON DIOXIDE, AND COMBUSTIBLES ANALYZER — a kiln gas recorder for cement, lime, bauxite and sintering applications. Bulletin 202

CARBON DIOXIDE, HYDROGEN CARBON MONOXIDE ANALYZER RECORDER, for blast furnace top gases and gas generators. Bulletin 203

HYDRAZINE ANALYZER, ranged 0-100 Parts per Billion, to record the N_2H_4 in boiler feedwater or steam condensate. Bulletin 204

OXYGEN/COMBUSTIBLES ANALYZER RECORDER with zero-center scale — to monitor generators and controlled atmosphere. Bulletin 208

PORTABLE pH METERS; three models for laboratory, plant and chemical processes. Bulletin 207

Special **SINGLE AND MULTI-POINT pH INDICATORS, RECORDERS AND CONTROLLERS** — including high pressure electrodes. Bulletin 208.

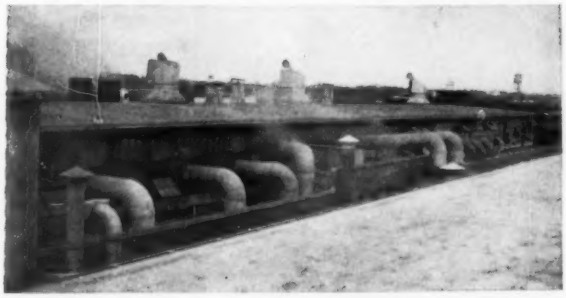
Visit us at Booths 471–473, or send for any of the above bulletins.

CAMBRIDGE INSTRUMENT COMPANY, INC.
3552 Grand Central Terminal, New York 17, N. Y.

PIONEER MANUFACTURERS OF PRECISION INSTRUMENTS

For more data circle 574 on Post Card

the downturn



and upturn at KVP

Same picture – different setting. Top shows complicated, space-wasting duct system which routed fumes back into plant for discharge through stacks. Bottom shows nine new 36" Aerovent "SP-7" Duct Fans installed to take fumes *up* and *out*, saving valuable floor space in busy working area. Just one of hundreds of successful Aerovent installations characterizing modern air engineering in action.

Write for free BULLETIN 400

All Aerovent Fans are rated in accordance with the Standard Test Code and U.S.D.C. Comm. Std. CS178-51.

Aerovent FANS

Aerovent

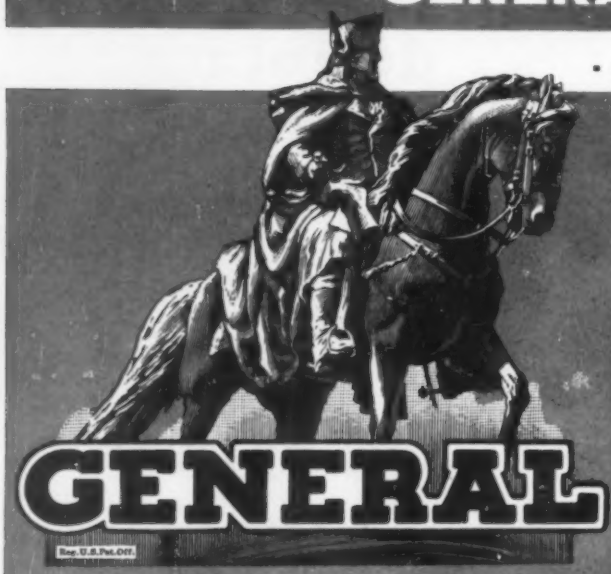
FAN COMPANY, INC.
ASH and BRUSH STS. • PIQUA, OHIO

Member Air-Moving and Conditioning Assn. (AMCA)

For more data circle 575 on Post Card

GENERAL

... a trusted name in coal



GENERAL

Reg. U.S. Pat. Off.

General Coal Company

123 SOUTH BROAD STREET, PHILADELPHIA 9, PA.

Branches:

Buffalo Charlotte, N.C. Cincinnati Cleveland Irwin, Pa. New York Norfolk

For many decades, General Coal and its Associated Companies have successfully met the varied needs of all types of coal consumers. You can rely on this experience for all your coal requirements.

WESTMORELAND COAL COMPANY

HAMPTON COAL

STONEGA COKE & COAL COMPANY

GLENBROOK STONEGA RODA

DENDRON CROSSBROOK

JEDDO-HIGHLAND COAL COMPANY

Hazle Brook Premium Anthracite

GENCO ANTHRACITE & BITUMINOUS COALS

For more data circle 576 on Post Card

STRAINER TROUBLES?

Better buy Armstrongs— they're trouble-free

STAINLESS SCREEN IS STANDARD—no maintenance problem here. Choice of wire mesh, or perforated.

GASKET CAN'T BLOW OUT—Stainless-asbestos gasket is locked in. You get a positive, leak-proof seal.

NO "FREEZING IN"—Straight bushing threads prevent it. Bushing and screen are always easy to remove.

NOW AVAILABLE IN AN EXPANDED RANGE OF SIZES

Sizes from ½" to 6"
Semi-Steel for pressures to 250 psi
Carbon Steel for pressures to 600 psi
Chrome Moly Steel for up to 950° F, 900 psi

For details, get Bulletin 605. Ask your local Armstrong Representative for a copy, or write today to:

ARMSTRONG MACHINE WORKS

8109 Maple St., Three Rivers, Michigan

SATISFACTION GUARANTEED

For more data circle 577 on Post Card

The easiest—and quickest—way to order bulletins and catalogs described in this magazine is to use the postage-free Reader Service Cards on pages 119–120.

All you need to do is circle the item numbers of those you want. Then fill in your name, job title, company name and address—and mail the card.

You may also use the Reader Service Cards to request information on products described, or literature mentioned in the ads—just circle the number below the ad.

POWELL

world's largest family of valves

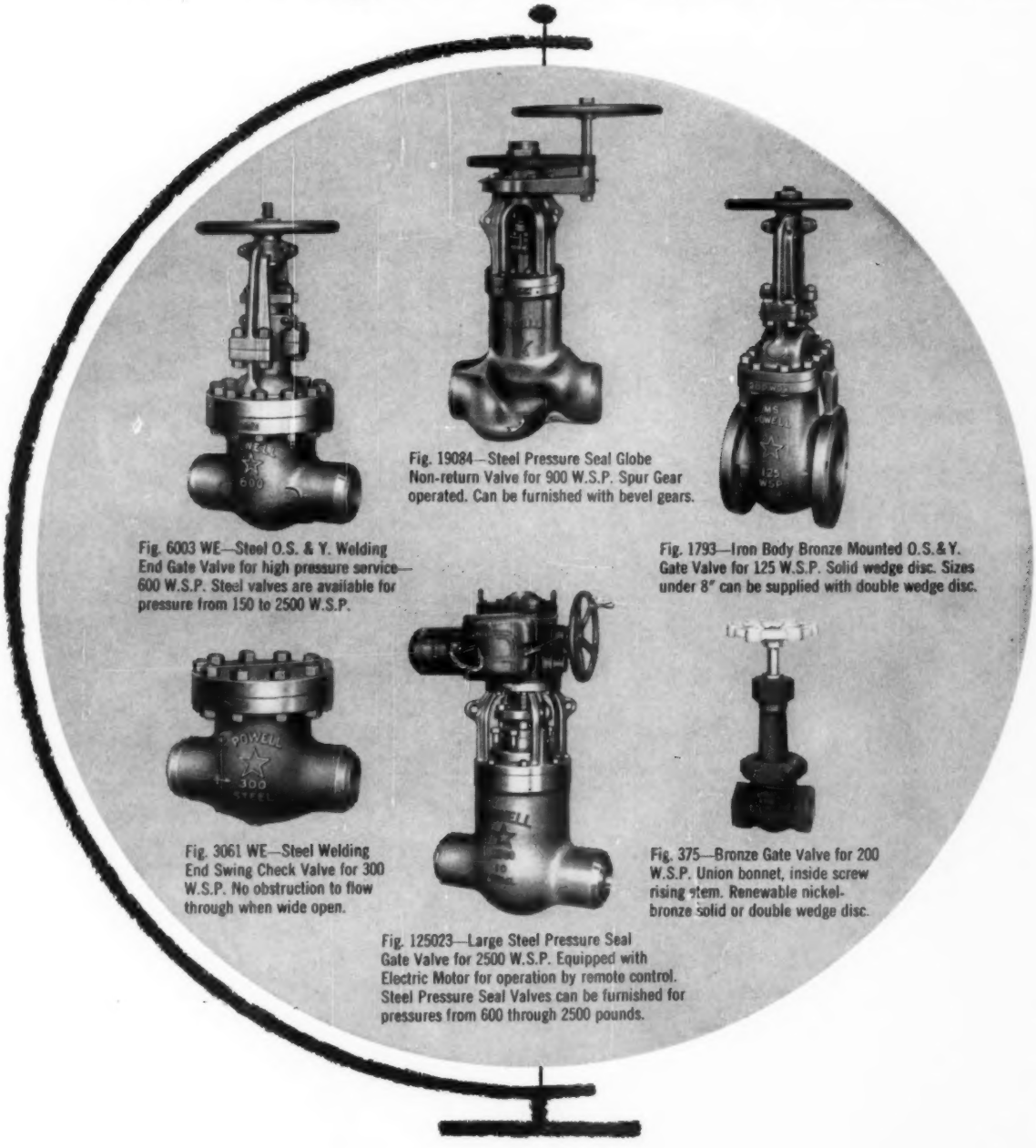


Fig. 19084—Steel Pressure Seal Globe Non-return Valve for 900 W.S.P. Spur Gear operated. Can be furnished with bevel gears.

Fig. 6003 WE—Steel O.S. & Y. Welding End Gate Valve for high pressure service—600 W.S.P. Steel valves are available for pressure from 150 to 2500 W.S.P.

Fig. 1793—Iron Body Bronze Mounted O.S. & Y. Gate Valve for 125 W.S.P. Solid wedge disc. Sizes under 8" can be supplied with double wedge disc.

Fig. 3061 WE—Steel Welding End Swing Check Valve for 300 W.S.P. No obstruction to flow through when wide open.

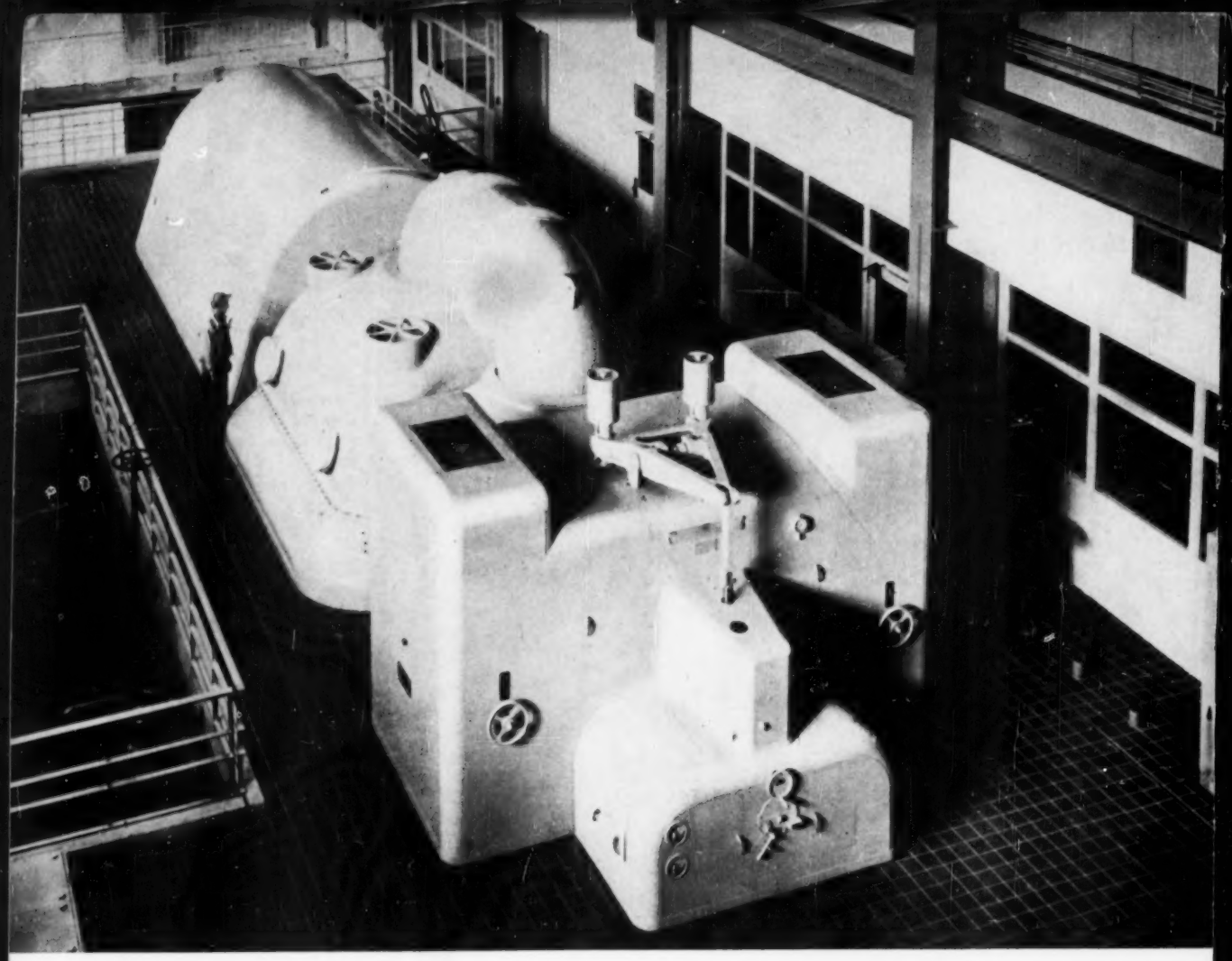
Fig. 375—Bronze Gate Valve for 200 W.S.P. Union bonnet, inside screw rising stem. Renewable nickel-bronze solid or double wedge disc.

Fig. 125023—Large Steel Pressure Seal Gate Valve for 2500 W.S.P. Equipped with Electric Motor for operation by remote control. Steel Pressure Seal Valves can be furnished for pressures from 600 through 2500 pounds.

FOR EVERY FLOW CONTROL PROBLEM Powell offers more kinds or types of valves, available in the largest variety of metals and alloys, to handle every flow control requirement. Your local valve distributor will be glad to tell you all about them. Or write to us for the full facts.

THE WM. POWELL COMPANY • *Dependable Valves Since 1846* • **Cincinnati 22, Ohio**

For more data circle 579 on Post Card



Get extra service life—extra protection with Texaco Regal Oil R & O

There's extra service built into Texaco Regal Oil R&O because it gives dependable protection against rust and oxidation as it lubricates. It's a first rate lubricant fortified with extra resistance to the formation of rust, sludge and foam.

The additives in Texaco Regal Oil R&O keep systems clean. The oil circulates freely throughout an extra-long service life. The bearings stay cool and the governor runs steadily and dependably.

There is a complete line of Texaco Regal Oils R&O to give long-term protection to any type or size of turbine. A Texaco Lubrication Engineer will be glad to help you select the right oil for your equipment. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write:

The Texas Company, 135 East 42nd Street, New York 17, N. Y.

LUBRICATION IS A MAJOR FACTOR IN COST CONTROL

(PARTS, INVENTORY, PRODUCTION, DOWNTIME, MAINTENANCE)

For more data circle 580 on Post Card